DOCUMENTS DEPARTMENT

ROOM

GOVERNMENT INFORMATION CENTER
SAN FRANCISCO PUBLIC LIBRARY

SAN FRANCISCO
PUBLIC LIBRARY

REFERENCE
BOOK

Not to be taken from the Library

OCT 3 1991

SAN FRANCISCO PUBLIC LIBRARY
3 1223 90189 6689

Digitized by the Internet Archive
in 2010 with funding from
San Francisco Public Library

http://www.archive.org/details/appendixtojourna19273cali

APPENDIX TO THE JOURNALS

OF THE

SENATE AND ASSEMBLY

OF THE

FORTY-SEVENTH SESSION

OF THE

LEGISLATURE OF THE STATE OF CALIFORNIA

VOLUME III

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO, 1927

43906 III

x328.794
C12:47 5
265034

VOLUME III.

1—Report of State Mineralogist, 1925–1926.

2—Report of Mineral Production for the year 1925.

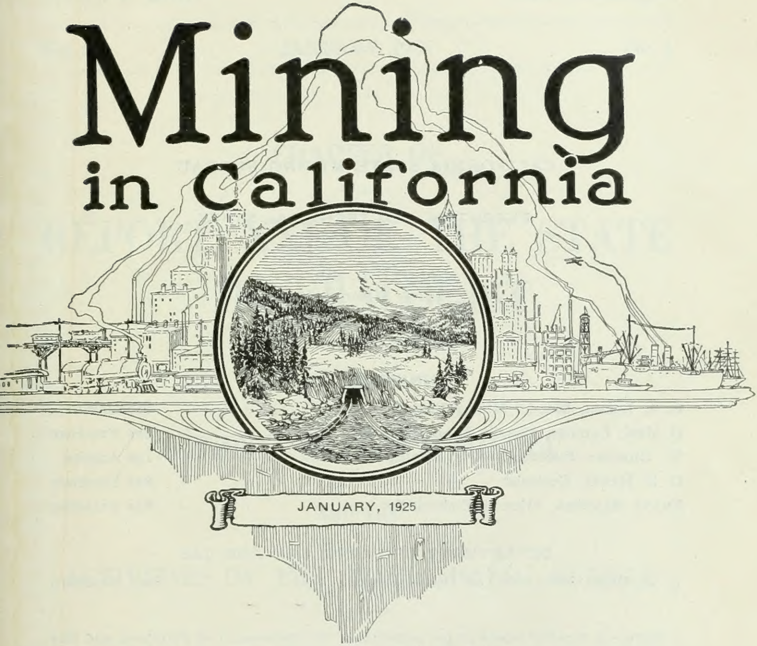
3—Report of the Hydraulic Mining Commission.

4—Report of Fish and Game Commission, 1924–1926.

5—Report of Division of Water Rights, 1924–1926.

6—Report of Department of Agriculture, 1925.

Mining in California



JANUARY, 1925

PUBLISHED QUARTERLY
CALIFORNIA STATE
MINING BUREAU
FERRY BUILDING
SAN FRANCISCO

83

CALIFORNIA STATE MINING BUREAU.

EXECUTIVE AND TECHNICAL STAFF

LLOYD L. ROOT
State Mineralogist

WALTER W. BRADLEY
Deputy State Mineralogist

MINING DIVISION

C. A. Logan, District Mining Engineer	Sacramento
C. McK. Laizure, District Mining Engineer	San Francisco
W. Burling Tucker, District Mining Engineer	Los Angeles
C. D. Hulin, Geologist	San Francisco
Frank Sanborn, Mineral Technologist	San Francisco

DEPARTMENT OF PETROLEUM AND GAS

R. D. Bush, State Oil and Gas Supervisor	San Francisco

Note.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT — State Mineralogist

Vol. 21 — JANUARY, 1925 — No. 1

CHAPTER OF

REPORT XXI OF THE STATE MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1925

CONTENTS.

Page

DISTRICT REPORTS OF MINING ENGINEERS ---------- 1
- Sacramento Field Division ---------- 1
- San Francisco Field Division ---------- 23
- Los Angeles Field Division ---------- 58
- Oil Field Development Operations ---------- 72

SPECIAL ARTICLES ---------- 77
- Mining Law ---------- 77

ADMINISTRATIVE DIVISION ---------- 122

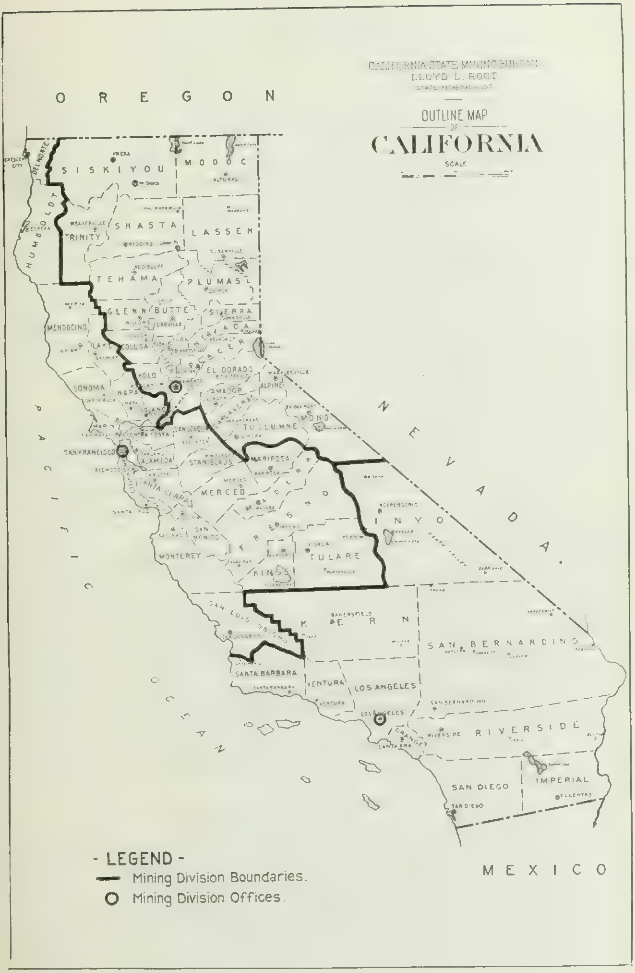
DIVISION OF MINERALS AND STATISTICS ---------- 123
- Statistics ---------- 123
- Museum ---------- 124
- Laboratory ---------- 124

LIBRARY ---------- 126

PRODUCERS AND CONSUMERS ---------- 132

EMPLOYMENT SERVICE ---------- 133

BUREAU PUBLICATIONS ---------- I



CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST

OUTLINE MAP
OF
CALIFORNIA

- LEGEND -

▬ Mining Division Boundaries.

○ Mining Division Offices.

PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. Logan, Mining Engineer.

SACRAMENTO COUNTY.

Geography and Topography.

Sacramento County is almost in the geographic center of the state, and lies principally in the Great Central Valley, with the eastern part of the county rising into the foothills of the Sierra Nevada Mountains. The elevation varies from thirty feet above sea level at Sacramento (Southern Pacific depot) to about nine hundred feet above the sea on the east side in the foothills. The Sacramento and American rivers unite just northwest of Sacramento city limits, the former flowing south and forming the western county line. Cosumnes River traverses the southeastern part of the county, flowing into Mokelumne River on the southern county line.

Transportation and Power.

The county and capital city are served by two transcontinental railways, the Western Pacific and Southern Pacific, which cross the county from north to south. The Central California Traction Company, running from Sacramento to Stockton, gives connection with the Santa Fe system, and the San Francisco-Sacramento electric line runs southwest to Oakland and San Francisco. A third electric interurban line, the Sacramento Northern, runs north as far as Chico. Three regular steamer lines ply between Sacramento and San Francisco on the river, giving freight and passenger service, besides which there are numerous other river cargo carriers. Two large power companies, Pacific Gas and Electric Company and Great Western Power Company supply electric power and the former company and Sacramento Gas Company supply gas. Transportation and power needs are thus seen to be well supplied. State highways radiate in all directions from Sacramento.

Mineral Resources.

Sacramento County has been an important gold-producing district for a long time. Previous to the enactment of anti-debris laws there was considerable hydraulic mining in the Folsom district and the gold production from this source and from drift mining, was as high as half a million dollars a year. In 1899 gold dredging began and gold production reached its peak between 1909 and 1917, the maximum yield being over two and a half million dollars in 1913. From now on, production from the gold dredgers will decline rather rapidly.

As a by-product industry, utilizing the waste rock piles of the dredged land, the rock-crushing industry has become important and has grown rapidly with the increased use of cement. Sand and gravel are also dredged in large quantities from the American River bed.

Brick, tile and a great variety of clay products are produced, using local clay mostly. Natural gas is supplied for domestic use, in part from wells. Granite is quarried, and platinum metals and silver are recovered as by-products of dredging.

In the eastern part of the county there are clay deposits which have remained undeveloped because of lack of cheap transportation. This is the only part of the county that is not covered by sand and gravel, and the older rocks are exposed, showing numerous quartz veins and stringers which have yielded many gold pockets. Finally the sand and finer gravel remaining at the bottoms of the dredger rock piles, after the upper portions have been removed and used for crushed rock, may one day be worked over for gold that escaped from the original operations.

CLAY INDUSTRY.

The business of manufacturing clay products has become an important one in the county and a great variety of building materials and household wares are being made. Local clays as well as white clay and sand from Placer and Amador counties are used.

Cannon & Company's Pottery (formerly Sacramento Clay Products Company). Owner: Cannon & Company, a close corporation. D. A. Cannon, president and general manager. Main office, 400 Forum Building, Sacramento. Pottery and clay beds are at Ben Ali siding, four miles from Sacramento, on what was formerly a part of Rancho del Paso, adjoining the Southern Pacific main line and state highway. There are about two hundred acres in the holdings.

About sixty per cent of clay is mined on the property. White clay and sand are brought from Lincoln and Ione deposits for making firebrick and are mixed in desired proportions with the local clay for making other products.

The clay on the property is a firmly consolidated yellowish brown sandy clay, red-burning, and locally called 'hardpan.' It is covered by a layer of reddish sandy loam, which is worked and marketed separately for molding sand (see *post*). The 'hardpan' layer varies in thickness but the entire bank is similar in quality, and is worked to a depth of fifteen to twenty feet.

Clay is dug by a steam shovel and horse scrapers, loaded in cars and hoisted to the plant, where it is dumped and aged under cover. It is fed by an auger feed to two dry pans for grinding, after which a bucket elevator lifts it to a Hum-Mer electric screen, screening to desired size depending on the product to be made. The clay then passes to storage bins, pug mill, and brick or tile machines. The stiff mud process is used. The products manufactured include face brick, interlocking and hollow tile, fire brick, hollow brick, Roman brick and other special shapes and sizes. The shrinkage of the local clay is one in thirteen, which is low compared with the white clays used, and shrinkage of different products varies with proportions of the clays employed. Fusibility of the firebrick is above 3000 degrees Fahrenheit and the face brick, 2100 to 2200 degrees Fahrenheit. For burning the brick and tile there are five down-draft round kilns, each with a capacity of 70,000 to 80,000 bricks. The bricks are burned five days and tile two and one-half to three days. Clay working machinery is operated from a main drive, using a 200-h.p. electric motor, and crude oil fuel is used for the kilns and steam shovel. There is a spur track to the plant from the railroad main line. Thirty-five to forty men are employed and the plant has a capacity of 1000 to 1200 tons a month.

Interlocking tile is used for bearing walls. This tile and the face brick have been used in the new California State Life Building and in other large buildings recently erected in Sacramento.

Bibl: State Mineralogist's Report XV, p. 404.

Natomas Company of California. An interesting possibility, and the promise of developing another by-product of gold dredging operations in the county, has been brought out by recent experiments by this company. Muddy water, which must be kept out of the river, has been a serious problem. Lately, tests have shown that this water in the dredge ponds during operation carries 6% to 10% solids by weight, and the material is so fine that little of it is coarser than 200 mesh, ranging from that size up to 20,000 mesh as tested by special apparatus. Chemically, it is a clay, being the finer-sized particles of the reddish 'hardpan' deposit of the older terraces formerly occupied by the river. The colloidal constituents are noticeable even after long standing.

This clay is of interest to potters because of its extreme fineness and some shipments have already been made to a pottery for further tests. It will probably be recoverable cheaply enough to permit marketing at a reasonable price.

MINERAL PRODUCTION OF

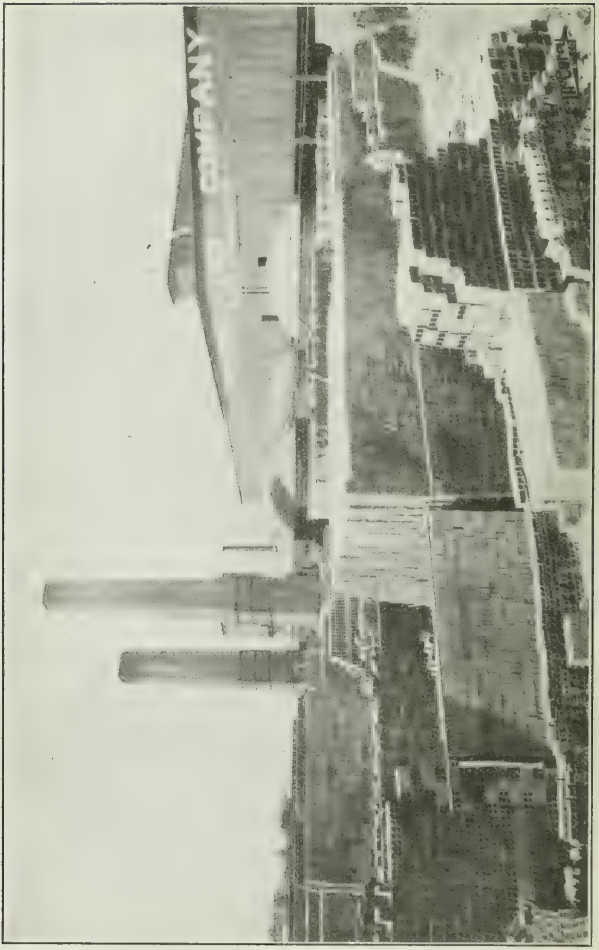
Year	Gold, value	Silver, value	Platinum		Brick	
			Ounces	Value	M.	Value
1880	$342,514					
1881	425,000	$1,000				
1882	400,000					
1883	480,000					
1884	270,000					
1885	353,522					
1886	280,000					
1887	158,526	176				
1888	150,000					
1889	210,075					
1890	193,585					
1891	142,830	4				
1892	121,900					
1893	90,091					
1894	70,326				11,250	$56,250
1895	145,873				13,125	65,625
1896	133,050				8,700	44,200
1897	93,050				3,100	16,700
1898	57,301				11,009	44,000
1899	115,906				15,600	93,600
1900	176,007	[2]473			8,900	53,400
1901	229,034	[2]253			12,236	62,180
1902	425,894	330			10,492	78,198
1903	335,646	234			15,000	120,000
1904	419,287	75			4,500	20,000
1905	668,382	206	40	$700	18,000	130,000
1906	986,624	3,640	11	200	12,000	108,000
1907	790,973	2,034			16,078	128,624
1908	1,166,055	1,621			7,936	63,491
1909	1,669,814	2,856				
1910	1,396,874	4,606				
1911	1,812,826	3,047			13,017	76,571
1912	1,712,587	3,544			26,073	161,535
1913	2,503,633	3,406			22,535	144,191
1914	2,164,491	3,481	223	7,108	22,862	160,923
1915	2,131,813	3,151	196	6,217	9,920	82,973
1916	1,833,855	3,578	195	8,892	8,924	91,615
1917	1,919,581	4,487	157	12,453	and	tile 122,886
1918	1,694,124	4,637	[3]			79,312
1919	1,714,79	5,276	[3]		[3]	
1920	1,575,033	4,534	[3]			248,433
1921	1,690,662	5,254	[3]			216,402
1922	1,350,749	3,392				259,263
1923	1,331,227	2,566	[3]			327,636
Totals	$35,933,513	$67,861	[3]822	$35,570		$3,061,008

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel, paving blocks.
[2] Recalculated to 'commercial' from 'coining value' as originally published.
[3] See under 'Unapportioned.'
[4] State Prison use, value estimated, as none reported.

SACRAMENTO COUNTY, 1880-1923.

Granite		Natural gas		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Cubic feet	Value	M. Cubic feet	Value		Amount	Value	Substance
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
....	....	....	....	....	....	....	
75,000	[4]$35,000	....	....	....	....	....	
85,000	[4]45,000	....	....	....	....	....	
....	....	....	....	$12,018	....	....	
207,845	62,339	....	....	28,074	....	$1,500	Pottery clay
4,840	4,000	15,000	$12,000	14,137	....	....	–
1,524	1,145	12,000	10,000	13,105	....	....	
2,137	3,139	11,750	11,750	14,157	....	....	
2,635	2,882	....	....	7,926	....	316	Copper
288	136	38,550	31,200	19,380	....	....	
20,471	2,222	31,680	30,518	18,176	....	....	
5,164	4,458	39,200	39,200	22,103	....	....	
4,327	1,614	43,564	43,564	32,386	....	....	
10,905	1,779	60,225	52,874	18,141	....	....	
26,105	4,625	60,225	52,874	13,936	....	....	
44,151	44,151	55,000	55,000	151,477	....	....	
31,660	23,745	60,000	60,000	235,210	....	314,438	Unapportioned, 1900-1909
68,684	59,947	49,203	49,203	164,592	....	....	
45,630	2,307	90,000	83,890	131,037	....	....	
....	....	100,000	96,000	197,733	....	....	
....	....	72,000	36,000	238,476	....	....	
....	....	80,000	40,000	253,235	....	....	
....	....	108,000	54,000	284,127	....	....	
....	....	[3]	....	194,718	227 lbs.	16	Lead.
					....	46,000	Pottery clay, natural gas.
....	....	[3]	....	199,839	....	27,000	Other minerals.
					310 tons	410	Pottery clay.
....	....	[3]	....	262,689	....	61,235	Natural gas, platinum, potash.
....	....	[3]	....	276,732	....	113,000	Clay and clay products.
					....	61,395	Natural gas and platinum.
....	....	[3]	....	180,563	....	57,591	Natural gas and platinum.
....	39,469	[3]	....	386,911	....	56,196	Natural gas and platinum.
....	51,500	....	....	412,667	....	111,991	Natural gas and platinum.
....	30,740	[3]	....	649,939	....	93,907	Natural gas and platinum.
....	$420,198	[3]926,397	$758,073	$4,433,484	....	944,995	



Plant of Cannon & Company at Ben Ali siding, near Sacramento, showing kilns, stockpiles and main building. (Photo by courtesy of the company.)

California State Life Building, Sacramento, showing rear walls faced with Cannon & Company's face brick. This company manufactures 132 shades of face brick, and the numerous shades give constantly changing effects at different times of day. (Photo by courtesy of the company.)

Panama Pottery. Owner, Panama Pottery Company, Incorporated, a close corporation. Victor Axelson, president. Andrew Anderson and Gustav Johanson, principal owners. Address: Post office box 797, Sacramento. Plant is just south of Sacramento city limits near Twenty-first street road.

This company owns no clay deposits at present, but buys red-burning clay locally and white clay from Lincoln and Ione. They manufacture

Fancy garden pottery, manufactured by Panama Pottery Company, Sacramento.

all kinds of household stoneware, including jars, water coolers and filters, jugs, mixing bowls, pitchers, etc. They also make fancy garden pottery and common and fancy flower pots. The company has just received patents on a new one-piece mold for embossed flower pots and are exclusive makers of this line which is made from white clays, burning cream color.

Clay for the various products is crused in a dry pan and elevated to a shaking screen, 30-mesh. It is then tempered and run through the pug mills, aged and run through the pug mill again. After molding, it stands for a short time on shelves and is taken thence to the dryer. White ware is burned 48 to 52 hours at a temperature of 2,200 degrees Fahrenheit, and red ware 37 to 42 hours at a temperature of 1800 degrees Fahrenheit.

Panama Pottery Company's plant, near Twenty-first street road, just south of Sacramento.

Equipment at the plant includes two pug mills, a drypan, glaze grinder, one flower pot machine, three jolly wheels, shaking screen, and two downdraft kilns with a total capacity of 16,000 gallons of stoneware. Crude oil is used for firing the kilns, and electricity for power. Sixteen men are employed. About ten days are required for a complete run, from setting to the time of drawing. The market for the goods is mostly in central California and deliveries are nearly all by automobile truck.

Sacramento Brick Company (formerly Riverside Brick Yard). A stock company, subsdiary to Sacramento Navigation Company. W. P. Dwyer, president. A. J. Foster, general manager. H. K. Johnson, secretary. Main office, Front and X streets, Sacramento. Brick plant is three miles south of Sacramento city limits, near Sacramento River.

Plant of Sacramento Brick Company, near Sacramento.

The company makes common brick exclusively. The deposit is clay, sand and loam, with no hardpan, and is worked about 16 feet deep by a steam shovel and drag-line scraper. Clay is loaded into four-ton side dump cars and hauled in trains by dinkey locomotives to the plant, where it is dumped into rolls, elevated to the pug mill and tempered. It passes thence to a soft-mud brick machine where bricks are pressed and cut and dusted with ground red grog from an outside grog grinder and storage bin. From the brick machine the bricks pass by wire cableway to steam rack dryers, where they are dried about 18 hours. They are then burned in open-draft field kilns for seven days at a temperature of 1,700 degrees to 1,750 degrees Fahrenheit. The kilns contain from 400,000 to 500,000 bricks each. Shrinkage in burning is about 6%. The plant has a daily capacity of sixty thousand bricks and employs a crew of sixty men. Crude oil is used for burning bricks, for the steam shovel and locomotives, and electric power for operating machinery. The direct operation of the brick machine requires only three or four men.

The company has another plant between the present site of operation and the river, but this has been abandoned. It was formerly operated at a daily capacity of 125,000 bricks during the dry season only, but the present operations are carried on steadily.

Bibl: State Mineralogist's Report XV, p. 403.

Muddox Pottery. Thirtieth and L streets, Sacramento. H. C. Muddox Company, owner. H. C. Muddox, president.

This company operates a plant for the manufacture of sewer pipe and chimney ware. They own some land at Carbondale, Amador County, where they dig clay, and also buy some common clay locally.

FUELS.

PETROLEUM.

Several wells have been drilled in Sacramento County in search of oil but to date none of these have been productive. In general, it may be said that we have no evidence of a positive character one way or the other, and there is no basis at present for any final decision as to whether or not oil underlies the Sacramento Valley. The wells that have been drilled have not been deep enough to penetrate the entire thickness of sedimentary strata deposited in the valley, and the fact that they have not encountered oil is not proof that oil does not exist. On the other hand, the valley is so deeply filled with sand and gravel of relatively recent age, that if oil-bearing formations do exist, and if the structure of these formations is such as to favor the retention of oil in commercial quantities, we have no means of proving it except by drilling. Every foot of the valley is covered by a thick layer of recent formations, which completely covers the older sedimentary formations and hides every hint of structure. The thickness of these recently deposited beds is uncertain in the valley proper, as wells drilled about 3000 feet deep in and near Sacramento have not penetrated the entire series of sedimentary beds. Due to the scarcity of fossils in these beds and the fact that shell remains and casts coming out of the wells are smashed to small bits by the drill, no characteristic fossils have been identified, so far as the writer has been able to find from inquiries made in the case of all wells drilled in later years to any important depth. The physical appearance of sand and shale coming from these wells (which is not a safe criterion) suggests that the lower portions of several of the deeper wells are in Cretaceous beds. Considerable stress has been put by promoters on surface features. These features are probably the result of erosion by modern streams and have no connection with underground structure in the valley proper. So far as could be learned, the gas encountered in many wells in this valley is 'dry' marsh gas, giving no sign of the presence of petroleum.

Associated Development Company drilled two wells one-half mile northwest of Clay station in the southeast corner of the county. Mitchell No. 1 well reached a depth of 1900 feet, where work was stopped without result. Mitchell No. 2 well was drilled to a depth of 2963 feet and some cuts of oil in chloroform were exhibited, but no oil was brought in.

The surface in this district is mantled by gravel and sand. The two wells are upon a slight ridge with its long axis striking northwest, but this ridge is probably an erosion feature. The Ione beds are the only ones positively identified, but the physical character of sand brought up is similar to the Cretaceous, in which the holes are probably bottomed.

Other wells were drilled a few years ago near Clay. One of these struck a pocket of gas which was ignited and burned for some time. No oil was brought in, although a report was given out that traces of paraffin base oil had been found. No samples of this were available when the writer visited the property, although the derrick showed the effects of the gas fire that had partly consumed it. It is presumed this gas was the 'dry' natural gas found in so many places in the valley.

Central Petroleum Company has under lease and option 256 acres of land in Lot 15, Sec. 53, T. 9 N., R. 6 E., about a mile and a half east of Del Paso Park. A prospect well has been drilled with a rotary rig to a depth of 2863 feet and has just been cemented (January 13) preparatory to a test of a reported oil sand near the bottom of the well. The date of test will be a few days after these notes go to the printer, precluding the possibility of giving the result of tests in this report.

NATURAL GAS.

The fact that numerous wells drilled in the Sacramento and San Joaquin valleys have brought in flows of gas, has been cited by many as an indication of oil, but none of these gas wells has ever given any oil indications, the gas being methane principally, with small amounts of inert gases such as nitrogen and carbon dioxide. Gas has been encountered in Sacramento County at depths ranging from a few hundred feet to 3000 feet.

Sacramento Gas Company. Main office, 916 Sixth street, Sacramento. Jens C. Jensen, manager. This company is at present supplying a large number of customers with gas from seven wells, located near Eighth avenue and Sacramento River, near American River at the end of Twenty-third street and along Sacramento River near Riverside boulevard. The wells vary in depth from 1700 feet to 3000 feet. They are artesian wells, giving immense flows of warm salt water, from which the gas separates at the top of the wells and is caught in traps and stored in large containers. Some gas is manufactured, as the natural supply is not sufficient to fill all demands.

The manager states that there has been no dimunition in the amount of gas flowing from the wells in the past ten years, but that, in fact, the present total output of seven wells is considerably greater than the former supply from eight wells. Output has been stimulated artificially, and is approximately 300,000 cubic feet daily now. It appears that the productive life of the well depends largely upon the care with which it is cased and the life of the casing. Uncased wells choke up with sand usually within a few years after they are drilled. The gas issuing from these wells is stated to be 'dry' marsh gas, averaging 84% methane, the balance being nearly all nitrogen. The product is clean and has a high heating value. The flow of gas is said to decrease in winter because of increased water pressure.

Bibl: State Mineralogist's Report XV, p. 405.

GOLD.

Sacramento is one of the leading gold-producing counties in the state, by reason of the dredging operations, which are now carried on by one company. A little drift mining and pocket mining is carried on, but the resulting gold production is small and irregular.

DREDGING.

The land suitable for gold dredging in this district extended from Blue Ravine, six miles above Folsom, along the present and former courses of American River to nine miles below Folsom, and is three miles wide in places, with most of the payable gravel on the south side of the river. Both the present river and the ancient courses and terrace levels have been worked. The ground varies in depth from 20 to 70 feet, but at present is being dredged 30 to 55 feet deep. The upper portion of the terrace gravels is covered by hardpan and clay, the entire bank being clayey and hard to dig.

The pioneer dredger [1] was put in operation in this field in April, 1899, by the Colorado Pacific Gold Dredging Company. It was a Risdon boat, with buckets of three and one-fourth cubic feet capacity. Four companies followed and worked until January, 1909, when they were consolidated under the corporation name of Natomas Consolidated of California. The Ashburton Mining Company finished its ground in 1913. The only other remaining company, the Wilkes-Barre Dredging Company, sold out to the Natomas Consolidated (now Natomas Company of California) in 1916, leaving that firm alone in the field.

A tabular history of Sacramento County dredgers was published in the Fifteenth Report of the State Mineralogist. Also some notes on the subject were published in 1917 in Bulletin 85 of the State Mining Bureau.

In 1916, eleven dredgers were in operation in this district, and in 1917 about twenty million yards of gravel were handled by ten dredgers, compared with six boats, handling about thirteen million cubic yards per annum at present.

Besides the ground dredged out, and that controlled by the Natomas company, there remain a few small parcels of land in the district that might be profitably dredged if the acreage were large enough to justify installation of a dredger. W. H. McDerby of Folsom has one such small property. There is also some ground left in Blue Ravine, which is said to be held by parties not desiring to sell for dredging. Blue Ravine is a shallow draw extending from near Mormon Bar, on the river above Folsom, southerly across the region east of the town and is underlain by an old gravel channel, which was partly drifted out in early days.

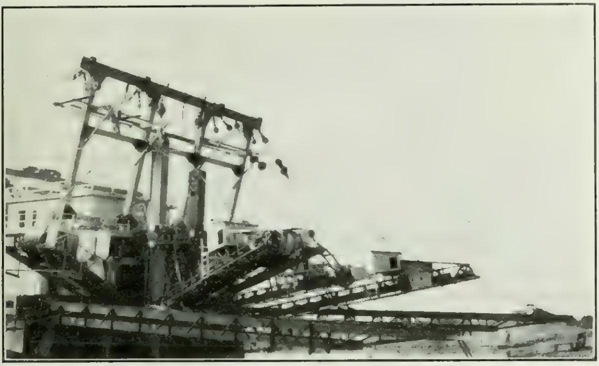
Some dredging has also been done on Cosumnes River between Bridge House and Michigan Bar. The Indiana Gold Dredging Company operated for several years there. They had an old dredger from Oroville which had 75 buckets of four cubic feet capacity and dug 27 feet below water. The ground was about 30 feet deep, of which the upper 15 feet were reported to be unprofitable to work. This overburden is similar to the terrace deposits now being dredged by the Natomas company, and equally hard to dig. The ground averaged 10 cents a yard in 1917. The exact acreage of possible dredging ground left here is unknown, but is believed to be not more than enough for one small dredger, as only 160 acres had been proved and part of this was worked out.

---

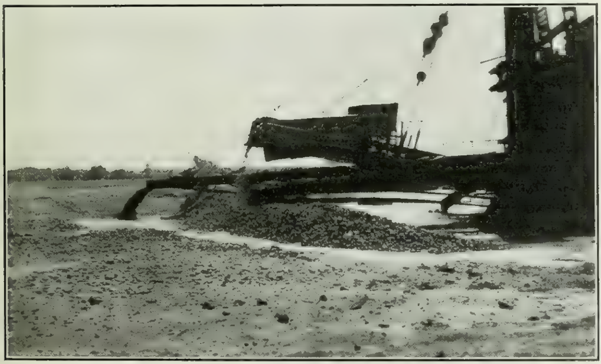
[1] California State Mining Bureau Bulletin 85, p. 27, et seq.

Natomas Company of California. Emery Oliver, general manager, Forum Building, Sacramento; L. D. Hopfield, manager of gold dredging department, Natoma; R. G. Smith, mining engineer. The repair shops and headquarters of the dredging department are at Natoma.

This company is now operating six dredgers. The ground near Folsom and Natoma and on the present river has been finished and all operations are now two to three miles south and west of Natoma and a mile southeast of Citrus, in the older and higher terrace gravel of quaternary age deposited 60 to 100 feet higher than the present level of the river and a mile and a half or more south of its present course.



Rebuilt dredger, designed to leave land practically level after dredging. Natomas Company of California.



Detail, showing method of operating. Land-leveling dredger near Natoma, Sacramento County.

The gravel is covered by hardpan and is mixed with clay, the whole bank having a reddish color and containing so much clay that it stands without caving and is much more expensive to dig than the present-river deposit. The boulders are more or less decomposed, indicating great age. Two dredgers are digging to a depth of 30 feet, two about 50 feet and two 55 feet below water level. One dredger was reconstructed and put on this ground in 1919, one in 1922, and one in 1924.

The tailing disposal equipment on all the dredgers but one has been remodeled so that the land is left approximately level after dredging. This is accomplished by dumping cobbles near the dredge, and running the finer tailing out farther, covering the coarse rock. (See illustration.) When this equipment was first installed, it was hoped that the land would be left in shape so it could be planted, and some small areas have been set out to trees and vines, but results were not up to expectations, as the finer sediment could not be held where wanted. Muddy water has been a serious problem, as it has to be kept out of the river as much as possible. The area of proved dredging land has been increased since 1917, but while the ultimate exhaustion of the placers has thus been postponed, the boats will be retired at intervals beginning in 1926 or 1927.

Three of the dredgers are equipped with Neill jigs and the recovery with these has been improved. The beds have been flattened and the velocity of approach of the feed to the jigs has been lessened. It has been found that, barring accidents, and breakage the most of the dredger machinery will last about as long as there is any ground left in the field. The wooden hulls, made from Oregon pine, last about ten years, one exception at Oroville having lasted eighteen years. A steel hull that had been used twelve years was recently moved, repaired and set up again with a promise of lasting another ten or twelve years. The minimum operating cost at present is five and one-half cents to six cents a yard, the average being six and one-half cents. The cost of operation in this district is much higher than at Oroville, due to greater amount of electric power used and loss of capacity because of muddy water and trouble in disposing of it.

The power bill for a dredger with 15-cubic-foot buckets, handling an average of 350 cubic yards an hour in this district, is reported by the company to average $1,500 a month more than for the same size dredger in the Oroville district, digging an average of 357 cubic yards an hour. A dredger digs about three-fourths as much in a year in this clayey terrace gravel as it could in the loose present-day river gravel. True bedrock has not been reached in this part of the district, the dredgers digging to a false bedrock of lava ash.

The dredgers handle, monthly, from 150,000 to 225,000 cubic yards each and a total per annum of about 13,000,000 cubic yards. About 250 men are employed in the dredging department.

Bibl: State Mineralogist's Report XV, pp. 405-413.

State Mining Bureau Bull. 85, pp. 20, 21, 27, 29, 97-98; Bull. 57, pp. 200-204.

U. S. Bureau of Mines Bull. 127, pp. 95, 99, 139-141, 164-174, 186.

DRIFT MINES.

This kind of mining has nearly ceased in the county, although a few men still earn a little in this way. There are a few places of small acreage left by the dredgers that might be drifted. It is also possible that some of the deeper ground, below the level reached by dredging, carries here and there a pay lead. But the few recent efforts to find the remaining sections of a deep 'blue lead' have failed.

Buckeye Flat Mining Company. J. J. Smith et al., owners. Property is on Alder Creek, one mile west of Natoma. George White and M. Tucher are in partnership with the owners and are working on the property.

An outcrop of pay gravel was discovered in the bank of Alder Creek, and a prospect shaft was sunk a few hundred feet east of this, just north of the state highway. At a depth of 12 feet they entered the gravel which is said to prospect well for a thickness of 4½ feet. A small headframe was put up, a gravel yard and sluices built, and a length of about 30 feet has been drifted and the gravel will be washed as soon as water is available. A pump and engine are being installed to pump water to sluices from Alder Creek, which passes near the shaft. Six hundred feet northeast of this shaft, another was sunk 40 feet deep, encountering similar prospects at a depth of 20 feet. This is underlain by gray lava ash and cobbles.

Cecilia Barrett, 170 East Cleveland Avenue, Stockton, owns a placer mining property of about 35 acres in the SW¼ of Sec. 1, T. 7 N.; R. 8 E.; and the E½ of NE¼ of Sec. 2, T. 7 N., R. 8 E., near Michigan Bar. This was formerly known as the Martin Welch claim.

Little interest is shown by landowners in the foothill section of this county in mineral possibilities of their lands, and such lands are devoted for the most part to winter grazing.

QUARTZ OR LODE MINES.

For a width of three to four miles along the easterly county line, the older rocks of the bedrock series are exposed as the valley passes into the rolling foothills. The westerly members of this rock series are diabase, amphibolite, and quartz diabase, followed on the east by beds of Mariposa black slate with a total width of one to two miles. At places in the slate, and on the east of it, amphibolite and diabase recur.

Forming an interesting feature, and not shown on the geologic map, are the dikes which traverse the black slate beds, having the same strike as the slate laminae. These are basic dikes, carrying considerable pyrite and usually altered. Associated with them are gold-bearing quartz veins and stringers. The slate, dikes and larger veins strike northwest and dip east. The dikes where fresh are apparently diabase. Cross stringers are in evidence where the dikes widen or have been stripped. Rich pocket shoots occur in the quartz and dike material evidently where cross stringers or zones intersect the main belt. The amphibolite schist on the east or hanging wall side of the black slate also carries these pocket deposits, some in small frozen bunches of quartz, and some apparently in joints in the schist itself.

On the *E. L. Butler Ranch*, adjoining the Mills-White Rock road in Sec. 20, T. 9 N., R. 8 E., considerable surface mining and shallow work has been done in the slate and schist.

On the *M. E. Strait Ranch*, ten miles south of Folsom in Sec. 4, T. 8 N., R. 8 E., is the site of the early-day placer mining camp and stage station called Walltown. The ravines, depressions and hillsides as high as water could be brought, were mined off with rockers and sluices. The deposit was the material from the erosion of the slate, quartz and amphibolite in the vicinity and had not been transported or water worn. It was shallow, not usually over two or three feet deep, and was stripped down to the hard rock.

On this ranch several shallow shafts have been sunk and a number of moderate-sized pockets found. The best of these was along a vein at the contact of a dike and the black slate. The main vein dipped east and the pocket shoot pitched south in the plane of the vein, evidently being along the intersection of a south-dipping vein striking east, with the main vein which strikes northwest. This shoot was followed down about thirty feet and mint receipts show a production of over $8,200 from it during 1916, when the last work was done. Most of this was recovered by use of a mortar.

There is an old two-stamp quartz mill, several gasoline engines, small air compressor, jackhamer drill, and blacksmith shop on the property which contains 120 acres. Address Carl D. Strait, Folsom.

GRANITE.

Folsom Granite Quarry is within the grounds of the state prison on the east bank of American River just upstream from Folsom. The rock is granodiorite. The quarry is operated by the prison authorities, using convict labor, and a great deal of the stone has been used in the prison buildings, walls and other works on the property, as well as for railroad ballast.

Bibl: State Mineralogist's Report XV, p. 416; X, p. 511.

MISCELLANEOUS STONE.

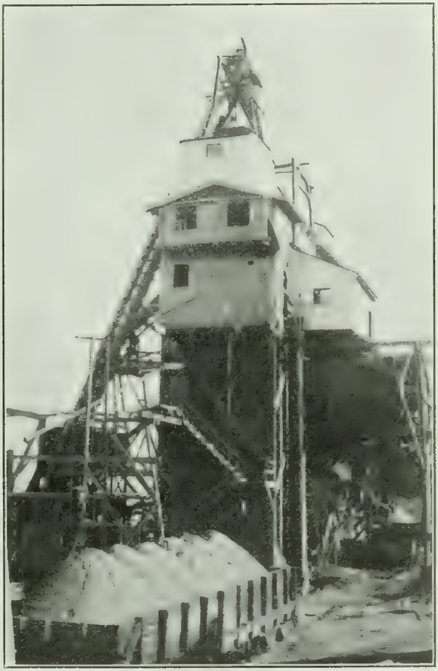
GRAVEL, CRUSHED ROCK, SAND.

American River Sand and Gravel Company. W. S. Hatch, president, San Francisco. Home office, Perkins, Sacramento County. G. S. Tyler, vice president and general manager at plant. This is a close corporation operating a plant near Mayhews on the Placerville branch of the Southern Pacific Railroad. They produce crushed rock, screenings, sand for concrete and plaster, and pea gravel.

The deposit is an old back channel of American River. Digging is done with a Brownhoist crane with 1½-cubic-yard bucket, which loads the sand and gravel into a 6-yard car. This is hauled by a Plymouth gasoline locomotive one-fourth mile to the plant and hoisted in a counterbalanced skip to the top of the plant, where it is screened and the cobbles over 3½ inches are returned to the ground to a Buchanan crusher. A sand jacket on the first screen diverts the sand and pea gravel. It was a problem to wash the sand clean enough to use for plaster. This was solved by installing Butters distributors, which have been yielding an excellent product.

After removal of the sand and crushing of the large oversize, the rock is re-screened, the oversizes going through a Symons disc crusher, and the different sized products are stored in bins in the lower part of the building, and over a spur track where railroad cars are loaded.

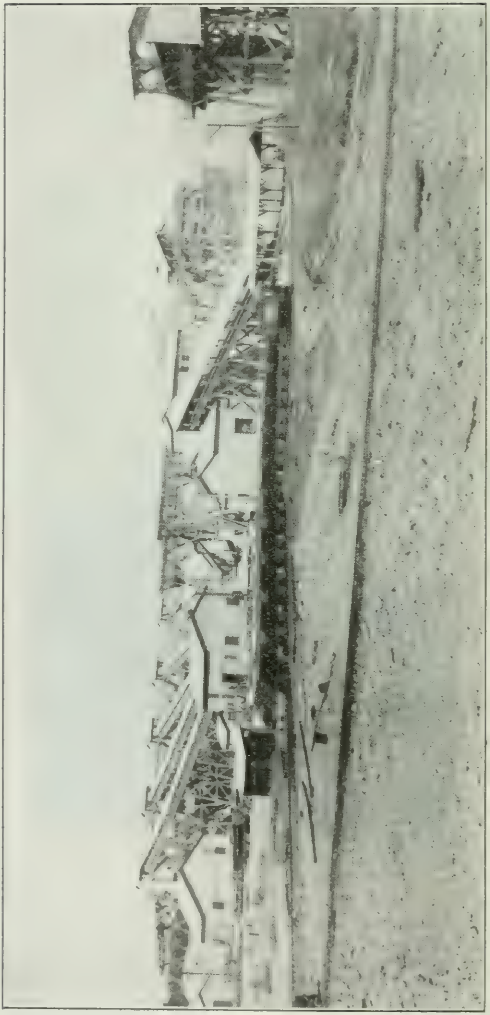
Coarse crushed rock is used for railroad ballast, and crushed rock up to 1¼-inch size for concrete work. Topping sand or gravel, from one-eighth to three-sixteenths inch is used for topping concrete surfaces, and washed sand is used for plaster and concrete. The plant employs 15 men and has a capacity of 500 cubic yards a day. Besides the equipment mentioned, and the numerous trommels, elevators and conveyors, there is a dragline scraper which has been used in working the property.



Plant of American River Sand and Gravel Company, near Mayhews, Sacramento County.

Capital Sand and Gravel Company (formerly Sacramento Sand Company). Office at plant, which is on the north bank of the American River near Twelfth street bridge.

Sand is raised by a 6-inch sand pump from behind a sand bar in American River. The product from the pump is discharged upon a stationary inclined screen at the top of a tower 75 feet high. Coarse rock and debris are screened off, and clay and mica are floated off through an overflow below the screen. The sand runs through pipe to



Fairoaks Plant of Coast Rock and Gravel Company, near Fairoaks.

a storage pile over a tunnel into which trucks can drive and be loaded by gravity. Gravel is dug by drag-line scraper from Arcade Creek, eleven miles northeast of Sacramento.

Most of the production is delivered direct to customers in Sacramento and vicinity by truck. As many as 13 trucks are used for hauling in the dry season, when about 20 men are employed, but the force is smaller in winter. The sand pump is mounted on a barge and operated by electric motor. It has a capacity of about 35 cubic yards an hour.

Coast Rock and Gravel Company (formerly Natomas Company No. 1 Plant). This company in 1920 leased from Natomas Company of California the rock deposits left from gold-dredging operations in the Fairoaks-Folsom district and the latter's large rock crushing and sizing plant one-half mile southeast of Fairoaks. Main office of company, 500 Call Building, San Francisco. Fred Wood, president; A. D. Hadsel, operating manager; William Hathaway, superintendent of Fairoaks plant.

The plant was described in the Fifteenth Report of State Mineralogist, since which time there have been few changes in equipment or mode of operation. The upper portion of the rock piles consists mostly of cobbles and pebbles, the sand and silt having settled to the bottom. Only the coarser, upper part of the piles is worked, leaving the bulk of finer material. A steam shovel digs and loads the rock into 5-ton cars which are hauled in trains of seven cars by dinkey locomotive a mile or more to the plant. The cars dump to a large belt conveyor 380 feet long, which takes the material to a large revolving screen, where sand, mud and fine gravel are washed out, passing down a sluice box fitted with riffles to catch the small amount of gold present. The coarse rock discharged by this trommel passes by conveyor to the crushing plant, where it undergoes successive stages of crushing and screening, producing various products which are finally distributed to different piles by a system of belt conveyors. A Brownhoist crane is used for loading railroad cars from the piles. Ample spur track facilities are supplied, connecting with the Placerville branch of the Southern Pacific Company. Electric power is used in the crushing plant.

When full handed, the plant employs 50 men and has a capacity of 2400 tons a day. The following products are sold:

Screenings (dust to three-eights inch).

Crushed rock in three sizes: Three-fourths inch, 1½ inches and 2½ inches.

Washed gravel in three sizes: Three-eighths inch, 1⅜ inches and 1½ inches.

Approximately 100 acres have been worked off and several hundred acres more remain.

This is an example of a plant marketing the waste from a mining operation where the profits per yard from the waste probably exceed those from the original gold dredging.

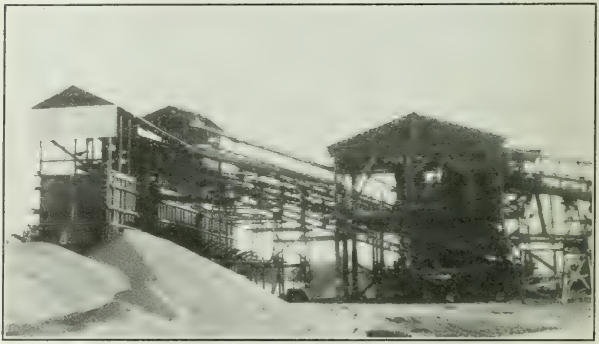
Bibl: State Mineralogist's Report XV, pp. 413–415.

Pratt Building Material Company. C. F. Pratt, president. Main office, 518 Hearst Building, San Francisco. The sand plant is on the south side of American River near the Twelfth street highway, just north of Sacramento city limits. M. M. Albee, superintendent of plant.

Sand is dredged from American River channel by a Sauerman dragline bucket, raised to the plant and washed, screened and stored in bins above the spur track for sale.

The sand is used for brick mortar and plaster particularly, and to a less extent for concrete. Screen size ranges up to one-eighth inch. Sand is brought to the bucket by high water, and variations in the size of sand occur at different seasons due to changes in the volume of water.

The plant has a capacity of 125 carloads a month and when fullhanded employs eight men.



Plant of Pratt Rock and Gravel Company, at Prattrock, adjoining Folsom.

Pratt Rock and Gravel Company. C. F. Pratt, president. Main office, 518 Hearst Building, San Francisco. Plant is at Prattrock, adjoining Folsom, on Southern Pacific Company's Placerville branch, where the company owns 158 acres of dredged land covered by dredger tailing piles, estimated to contain 6,000,000 tons of rock. Jos. W. Pike, superintendent of plant.

The rock is dug and loaded by a steam shovel, and hauled by steam locomotive in 4-yard cars three-fourths of a mile to the plant, where it is elevated by a 30-inch belt conveyor 415 feet long to the first trommel. Sand is washed out and passes over riffles in a sluice box. Gravel up to 1½ inch in size is also screened here and goes by a belt conveyor to an outside stock pile. Sizes between 1½ and 4½ inches go by belt conveyor to the secondary crusher bins, and sizes over 4½ inches go directly from the first screen to the primary crusher, a Worthington 36-inch by 24-inch jaw crusher. Product from this and from the secondary crusher bins is broken in two 6-inch Worthington Superior McCully crushers, from which it is raised by a bucket elevator to a second trommel, with 2½-inch holes. Oversize is returned to the secondary crushers and undersize is taken by a belt conveyor to the top of the bin house, where it goes through a trommel 24 feet long which separates three sizes of product, which are stored in eight separate bins below, from which railroad cars are loaded, or in stock piles beside the railroad tracks. The plant has a capacity of 1000 to 1200 tons in eight hours and there are 26 men in a full crew.

The following products are made:

Screenings, size three-eighths inch to dust.

Crushed rock, three sizes, three-fourths inch, $1\frac{1}{2}$ inch and $2\frac{1}{2}$ inches.

Washed gravel, size one inch to $1\frac{1}{2}$ inches.

A Brownhoist crane on railroad trucks is used for loading rock from stockpiles into railroad cars and for switching cars. The plant is served by a spur from the Southern Pacific Company's branch, and has 3800 feet of broad-gauge track besides its own narrow-gauge tracks.

Sacramento Mortar and Sand Company. Plant and office on south bank of American River at end of Twenty-fourth street, just north of Sacramento city limits. Will Thomas, manager.

A 7-inch sand pump and 100-h.p. motor are installed on a barge which is anchored in the river and can be moved about as occasion requires. Sand is pumped to the top of the plant where it is screened and goes into a settling tank, where the clean, heavy sand settles to the bottom and is drawn off, agitation being sufficient to float off the clay. Sand is then raised by bucket elevator to the bunkers, which have a storage capacity of about 500 cubic yards. The plant has a capacity of 400 cubic yards in eight hours. Only two men are required to carry on the pumping and washing operations.

A mortar plant is just being built, and the company has recently purchased the rights for seven counties for the manufacture of concrete bricks under the Shope Patents. The installation of the patented machinery is planned for the near future. Sand dredged on the property will be used with cement to make the bricks.

At present the sand is used principally for brick work, plaster and concrete in Sacramento and no spur track has been built, all deliveries being by truck.

MOLDING SAND.

The sandy loam forming the surface soil of part of the Sacramento Valley in and near Sacramento has been found suitable for molding sand for some purposes. This soil layer is variable in depth, but usually quite thin. It is fertile and easily worked, and as it is a valuable soil, in a district where land is rather high priced and a great many gardens are planted by city and suburban owners of lots and small acreage, there is a question as to whether it is not of greater ultimate value when thus used, rather than for molding sand, except where the underlying hardpan is to be used for clay.

Cannon & Company. Office: 400 Forum Building, Sacramento. Deposit is upon the company's property near their pottery (which see).

The turf is removed, and after plowing, the sandy loam is dug with a dragline scraper, which delivers to a belt conveyor and thence to dump bottom wagons in which the sand is hauled a short distance to a loading bin beside the railroad spur. Here the load is dumped into a pit, picked up by a small bucket elevator and loaded into railroad cars.

The dragline scraper, belt conveyor and electric motors are housed in a small portable building which can be moved around by a team of horses.

The deposit of molding sand upon this property varies from less than a foot to three feet in thickness, and does not cover the entire acreage, but occurs in irregular shaped areas on the higher, rolling land. It is a medium-fine-grained reddish-brown sandy loam, consisting of angular sand grains and clay, free running when dry but slightly coherent when wet. The underlying hardpan is used for clay products after the molding sand has been removed.

Three men are employed irregularly, depending on amount of sales.

PLATINUM GROUP METALS.

This subject was covered in considerable detail in Bulletin 85 of the State Mining Bureau, stock of which is now exhausted, and the following is summarized from it.

These metals occur in the gravel deposits along the ancient and modern courses of American River and its tributaries and along Cosumnes River, and have been recovered entirely as a by-product of the gold dredging operations.

Large areas of serpentine cross these watersheds in several belts, trending slightly west of north, across the counties east of Sacramento County. Chromite occurs frequently in these areas and was mined extensively during the war. Presumably the platinum group metals came from this serpentine or from the parent rock from which this serpentine was derived.

The average of five assays made upon lots of from thirty to eighty ounces each, showed 43.49% platinum and three of these showed 22.57%, 23.13% and 25.17% iridium. Osmium was not accounted for, but probably averaged about 30%.

The record of platinum production from this county is incomplete prior to 1914. For a few years following 1914 it was about 200 ounces per annum, decreasing rapidly until at present it is about 100 ounces a year. The Senn Panning-Motion Batea formerly used to make the final recovery of platinum from the black sand concentrate has been replaced by a homemade centrifugal concentrator.

Bibl: State Mining Bureau Bull. 85, pp. 27-29.

REFRACTORY SAND.

Burns Property. T. M. Burns, 2207 N Street, Sacramento, owner and operator. Property is a mile southeast of Ben Ali, and some land also just west of Ben Ali is being worked.

Sandy loam, slightly more clayey in places than similar loam used for molding sand, is dug by hand and horse scrapers, shovelled into wagons and hauled to railroad cars for shipment. This material is being used for refractory purposes, and the shipments are irregular depending on demand. The deposit is shallow and similar in occurrence to the molding sand mentioned elsewhere.

BIBLIOGRAPHY ON SACRAMENTO COUNTY.

Publications of California State Mining Bureau.

Report of State Mineralogist:
- Eighth Report, pp. 556–557 (General).
- Tenth Report, pp. 496–514 (Water resources, well logs, mineral resources).
- Eleventh Report, pp. 334–336 (Water resources).
- Twelfth Report, pp. 225–227 (Gold placer mines).
- Thirteenth Report, pp. 316–318 (Gold placer mines).
- Fifteenth Report, pp. 400–418 (General, mineral resources).

Bulletins:
- Bull. 38, pp. 47, 48, 225–253 (Structural and industrial minerals).
- Bull. 57, pp. 174–204 (Gold dredging).
- Bull. 85, pp. 27–29 (Gold dredging, platinum).

United States Geological Survey Publications:
- Folio 3, 5, 11. Reprint (Areal and economic geology).
- Prof. Paper 73 (Auriferous gravels).
- Water Supply Papers, 298 and 375a.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

MONTEREY COUNTY.

Introduction.

Few, if any, counties of the state have a more interesting early history than that of Monterey.

The settlement of the Monterey peninsula began with the establishment of a mission and presidio at Monterey in 1770, although the bay was entered and explored by Visaino 168 years previously, in 1602, and it had been discovered and named still earlier by Cabrillo.

Comprised of rich valleys, interspersed between the Santa Lucia, the Diablo, the Gavilan and lesser spurs of the Coast Range, and with a rugged coast line of unsurpassed beauty, Monterey County has been from the earliest period a mecca for travelers.

The more fertile valley lands and much of the mountainous portions, originally included in Spanish 'grant' lands, are held as large 'ranchos.' There still remain individual ranches of 35,000 to 40,000 acres each, and this condition has not been conducive to full and intensive development of the county's resources, either along agricultural or mining lines.

The principal industries are agriculture, stock-raising, and dairying. The mining industry and the commercial fisheries are also of importance. The mining industry is relatively undeveloped, although the mineral resources of the county are varied and extensive.

There is an old shaft on the Alisal Rancho, a few miles east of Salinas, sunk more than 100 years ago, in which ore was found containing gold, silver, lead, and copper values. Despite such early beginning, the precious metals have been found in important quantities in only one district within the county, and it is to the enormous deposits of the more common structural and industrial materials and fuels, that the mining industry must look for its greatest returns.

Most of such deposits are found on land that long ago passed into private ownership. As such deposits can not be 'located,' there is little inducement for the prospector, and their development by the owners, whose interests have been confined to other lines, has been neglected.

The continued growth of manufacturing industries on the Pacific coast, however, has created a growing market for these products, and an era of increased development and production is apparently at hand.

It is the purpose of this report to bring together data pertaining to the minerals of the county, so far as they have been investigated by the State Mining Bureau, in the hope that their development and utilization may be hastened.

DESCRIPTION.

Geography.

Monterey is one of the central coast counties, extending from the Pajaro River, which empties into Monterey Bay, south to the sixth Standard Parallel. It is bounded on the north by Santa Cruz County. San Benito, Fresno and Kings counties adjoin it on the east, and San Luis Obispo County bounds it on the south. Its area is 3330 square miles and its population 27,980 (census of 1920). The main line of the

Southern Pacific railroad, coast division, runs through the county, connecting it with San Francisco and Los Angeles, as also does the state highway, a concrete paved road. Connecting county roads are kept in good condition, and it is only in the more remote mountainous sections that economic transportation becomes a problem. The completion of the proposed road along the coast, connecting Monterey and San Luis Obispo, now open from the north to a point 18 miles beyond Big Sur and from the southern end as far north as Salmon Creek, will open up a large area which has heretofore been accessible only by water or steep trails, and one whose mineral resources are scarcely known.

Topography.

Among the principal topographic features is the great central Salinas Valley, the largest of the intermountain valleys of the coast region; being about 100 miles long by 6 to 10 miles in width, and lying parallel to the coast. Between the valley and the coast rises the Santa Lucia Mountain Range which culminates in a number of peaks, some reaching nearly 6000 feet above sea-level. Along the eastern side of the valley, and with their crests forming the eastern boundary of the county, are the Gavilan and Diablo Ranges. Among the smaller valleys are the San Lorenzo, San Antonio, Cholame, Carmel, and Nacimiento. In each of these the principal axis extends northwesterly, parallel with the general structure of the mountain ranges.

Geology.

The geology of most of Monterey County is described and mapped in Bulletin No. 69, of the State Mining Bureau, 'Petroleum Resources of California,' and the folio accompanying it. It is also shown in lesser detail on the Geological Map of California (1916).

The Santa Lucia Range has a core of granitic rock. This is exposed in Santa Lucia Peak at an elevation of 5967 feet, and throughout the territory between Carmel River and Sur River, either along the coast or in the river cuts. Limestone and gneiss overlie the granite in places, and make up Pico Blanco, Ventana Cone, Marble Peak, Twin Peak, and Cone Peak. Most of the area from Mill Creek southward to Three Peaks and bounded on the northeast by Nacimiento River, is made up of Franciscan sandstone and shale, with intrusions of serpentine. It is in the region of these serpentine intrusions and the later intrusive acid dikes that the important mineral deposits of the Los Burros district are found. The geology of the Los Burros district has been described in considerable detail by Hill.[1] There is evidence throughout of much faulting, and the precipitous coast follows a fault line. Monterey sandstone and conglomerate flank the mountains on the southwest side of Nacimiento River, and dip towards the valley. Most of the older sediments exposed east of the Nacimiento consist of Monterey shale, which is considerably folded east of Jolon.

Along the coast, resting unconformably on the granite and Franciscan rocks, are raised beach deposits. The settlment of Gorda is located on the more recent of these terraces. This terrace is noticeable in Willow Creek, one-half mile back from its mouth, and also along the coast north of Gorda. These terraces are important in relation to placer gold. It is thought that the placer deposits near Jolon originated in a similar manner.

---

[1] Hill, J. M., The Los Burros District, Monterey County, California. U. S. Geol. Survey Bull. No. 735-J, 1923.

In the northeastern part of the county, in the Gavilan Range, granite occurs associated with gneisses and schists. In places these rocks contact with massive beds of metamorphosed limestone, and dolomite is commonly associated. Feldspathic segregations give rise to commercial deposits of feldspar along the range as far south as the Pinnacles. In the vicinity of the Pinnacles there is a small area where volcanic activity has taken place and extrusive volcanic rocks are in evidence. Farther south Tertiary sandstone and shales predominate. A long narrow belt of the Franciscan rocks, including slates, sandstones, and much schist and serpentine, extends from Priests Valley southeastward beyond Parkfield. Workable coal beds are exposed in the vicinity of Priests Valley and the principal quicksilver deposits occur in the Franciscan, not far from Parkfield.

MINERAL RESOURCES.

The last general report on the mines and mineral resources of Monterey County appeared in the Fifteenth Report of the State Mineralogist (1915–1916). Bulletin No. 78, 'Quicksilver Resources of California' (1918), describes the quicksilver mines in detail. A few additional notes on mining activities appear in the Seventeenth Report of the State Mineralogist (1920). The petroleum possibilities are discussed in Bulletin No. 89, 'Petroleum Resources of California' (1921).

The first ten days of January, 1925, were spent by the writer in a survey of the county in an endeavor to collect up-to-date data on all the mining activities and mineral resources. The Los Burros district was not visited; but, as there is a report of the U. S. Geological Survey, of recent date, on this district,[2] it was thought advisable, on account of the limited time available for field work, to spend it in areas more easily reached. Appreciation is here expressed for the courteous treatment and cooperation of operators, owners and chambers of commerce throughout the county.

The following commercial minerals are of record as occurring in Monterey County: Arsenopyrite, barite, bitumen (asphaltum), calcite (limestone and marble), chromite, cinnabar (quicksilver), clay, coal, copper, diatomaceous earth, dolomite, galena, garnet, gold, graphite, gypsum, magnesite, magnetite, malachite, metacinnabarite, molybdenite, orthoclase (feldspar), psilomelane (manganese), quartz, salt, serpentine (asbestos), and stibnite. Not all of these have been produced in commercial quantities, however, nor is it known that all occur in sufficient quantity to be of value. About ten other mineral species of mineralogical interest only have also been noted.

The following table gives the complete recorded output and value of the mineral production of the county from the earliest available record, 1889, to and including 1923:

---

[2] Hill, J. M., *op. cit.*

Year	Gold, value	Silver, value	Brick		Diatomaceous earth		Lime		Limestone	
			M.	Value	Tons	Value	Barrels	Value	Tons	Value
1889	$3,500									
1890	11,815									
1891	3,000									
1892										
1893										
1894	8,000									
1895										
1896										
1897									2,000	$2,000
1898			400	$2,400					2,049	1,640
1899			200	1,400					7,744	6,970
1900			200	1,600					8,000	10,800
1901	13,800								5,463	7,500
1902	6,860	$18					22,000	$13,200		
1903	8,920						26,000	23,400	6,516	9,000
1904	6,941		200	1,600			3,240	3,240	4,550	21,500
1905	4,000						10,000	10,000		
1906	625	3			80	$400	40,000	50,000		
1907	1,076	9					100,000	125,000		
1908	1,318	9	426	3,838			50,000	50,000		
1909	333	5	300	2,900	500	3,500	50,006	62,507	10,658	45,678
1910	[2]1,013	10	993	9,957	500	3,500	30,894	29,349	2,500	7,500
1911					850	5,950			2,000	6,000
1912	[3]7,647	67							6,000	8,000
1913	6,491	27			1,700	6,800			6,500	13,000
14 19	4,000	20								
1915					[4]					
1916					[4]					
1917					[4]				[4]	
1918					[4]					
1919					[4]					
1920					[4]					
1921					[4]					
1922										
1923										
Totals	$89,339	$168	2,719	$23,695	[4]3,630	$20,150	332,140	$366,696	[4]63,980	$139,588

[1] Includes crushed rock, rubble, sand, gravel.
[2] Includes Monterey, San Luis Obispo and Santa Cruz counties.
[3] Includes Los Angeles and San Luis Obispo counties.
[4] See under 'Unapportioned.'
[5] Includes molding, building, blast, filter, roofing sand.

COUNTY, 1889-1923.

Mineral water		Glass sand		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Gallons	Value	Tons	Value		Amount	Value	Substance
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	$1,500	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
5,000	$1,000	----------	----------	----------	----------	----------	
2,000	200	----------	----------	----------	----------	----------	
21,000	1,050	----------	----------	14,025	----------	----------	
1,500	750	----------	----------	8,258	----------	----------	
20,000	4,000	----------	----------	2,775	----------	----------	
15,000	3,250	4,500	$15,750	8,869	200 tons	$1,000	Coal.
15,000	1,750	4,500	12,225	5,200	----------	----------	
55,000	1,250	5,989	4,967	3,167	61 tons	732	Asphaltum.
25,000	1,000	8,295	7,272	----------	124 tons	1,488	Asphaltum.
5,000	1,000	9,257	8,127	----------	----------	----------	
24,000	12,000	750	1,125	----------	----------	----------	
120,000	12,000	11,065	8,178	----------	4,800 tons	24,000	Coal.
----------	----------	6,805	5,120	31,727	7 flasks	296	Quicksilver.
10,000	2,000	6,496	4,872	43,351	1 flask	49	Quicksilver.
					----------	344,789	Unapportioned, 1900-1909.
----------	----------	7,594	5,890	47,487	7 flasks	317	Quicksilver.
					700 tons	5,000	Feldspar.
					200 tons	2,500	Fuller's earth.
----------	----------	----------	----------	27,011	11,000 tons	4,950	Clay.
20,000	7,000	9,016	7,916	60,119	4,000 tons	6,000	Clay.
20,000	7,000	9,141	9,192	12,556	320 tons	3,200	Coal.
					----------	78,332	Other minerals.
26,000	7,900	9,210	7,633	39,202	35,000 tons	12,000	Clay.
					300 tons	2,700	Fuller's earth.
					5,992 tons	17,976	Coal.
					----------	9,450	Other minerals.
					700 tons	3,500	Feldspar.
					450 tons	3,150	Fuller's earth.
8,200	2,050	[4]	----------	32,799		50,137	Coal, feldspar, diatomaceous earth quicksilver, silica.
5,900	590	----------	----------	58,623	----------	50,659	Barytes, feldspar, diatomaceous earth quicksilver, salt, silica.
	----------	[4]	----------	57,810	6,392 tons	23,468	Dolomite.
					----------	57,508	Barytes, diatomaceous earth, limestone, mineral water, quicksilver salt, silica.
----------	----------	[4]	----------	52,697	4,900 tons	25,950	Dolomite.
					700 tons	3,800	Feldspar.
					----------	37,240	Barytes, coal, diatomaceous earth, quicksilver, salt, silica.
----------	----------	[4]	----------	73,031	8,280 tons	29,120	Dolomite.
					----------	43,353	Barytes, coal, feldspar, diatomaceous earth, salt silica.
200	20	[4]	----------	[5]84,056	5,755 tons	26,238	Dolomite.
					----------	16,135	Barytes, coal, feldspar, diatomaceous earth, salt, silica (glass sand).
----------	----------	[4]	----------	[5]63,316	2,500 tons	8,750	Dolomite.
					----------	98,089	Asbestos, coal, diatomaceous earth mineral water, salt, glass sand.
----------	----------	[4]	----------	[5]86,180	----------	169,139	Asbestos, coal, dolomite, quicksilver, salt, glass sand.
----------	----------	[4]	----------	[5]140,724	----------	81,298	Asbestos, diatomaceous earth dolomite, mineral water, quicksilver, salt, glass sand.
[4]398,800	$65,810	[4]92,618	$98,261	$954,483	----------	$1,243,313	

ARSENIC.

Riley Ranch Deposit. The Riley ranch comprises about 1600 acres situated 12 miles east of Chualar at the head of Chualar Canyon, and takes in the summit of the Gavilan Range. J. F. and J. T. Riley, owners, Box 424, Salinas, California. The summit of the ridge on this property is made up of heavy limestone beds which have here been intruded by deep-seated igneous rocks. Along the irregular contact of these formations there is a mineralized zone showing arsenopyrite, magnetite, limonite, azurite, and malachite. An open cut and short tunnel at one point developed a fair showing of arsenopyrite which would probably have some value as an ore of arsenic if the price of arsenic again reaches the high point it did a year or so ago. More or less magnetite and limonite are associated with the arsenopyrite. Several hundred yards from this point a shaft has been sunk about 30 feet on an iron-stained outcropping showing oxidized copper minerals. Material from the bottom of the shaft is said to carry values in gold and silver, as well as copper. The deposit was opened up in 1923. No work is being done at present.

ASBESTOS.

Burro Asbestos Mine. Walter R. Harris, of Bryson, Monterey County, and J. E. Barrett, 903 Sandercock St., San Luis Obispo, the owners of this deposit, opened it up in 1920, and have continued development by means of open cuts and tunnels. The deposit is located about 30 miles southwest of King City. There is a good auto road to Bryson and then 4 miles of trail. The property comprises 7 claims and covers an area of serpentine containing veins of chrysotile asbestos with fiber up to 1½ inches in length and of good quality. The deposit has a width of about 300 feet and it has been traced over a length of three claims. With the exception of small lots shipped to the U. S. Asbestos Co., Downey, California, and other consumers for testing and trial, there has been no commercial production.

ASPHALTUM.

Deposits of asphaltum occur in three districts in Monterey County. In the region southwest of Bradley, near the Nacimiento River, sandstone impregnated with oil is exposed and has been quarried for use on the roads and bridges about King City.

East of Parkfield at the foot of Table Mountain and on the west side of Little Cholame Creek oil-impregnated rocks are exposed which have been a stimulus to oil prospecting.

Another asphalt quarry two miles west of Lonoak could still furnish considerable road material but it has not been worked for many years.

Bibl: State Mineralogist's Report XVIII, p. 229; Bull. No. 69, Petroleum Industry of California, pp. 418–438; U. S. Geol. Survey 22d Annual Report, pp. 379–452.

BARITE.

Operations have ceased at the deposit of barite on Fremont Peak. Barite was formerly produced here by A. R. Haskins, of Hollister, under a lease from the owners, J. and H. Bardin, Salinas, California. It is reported worked out.

Bibl: State Mineralogist's Report XVII, p. 156.

CHROMITE.

Detached masses of chromite are found in the serpentine on Table Mountain near Parkfield. None has yet been produced commercially.

CLAY.

There has been no recent production of clay reported from the county. A clay pit and brickyard were at one time operated at the south end of Salinas, near the cemetery, and several thousand tons of clay have come from a deposit owned by J. C. Jens, 636 W. Adams St., Los Angeles, situated east of Chualar.

Bibl: Preliminary Report No. 7, 'Clay Industry in California,' p. 65.

Echstine Deposit. A deposit of white plastic clay is reported to occur in T. 24 S., R. 8 E., on the property of Mrs. G. P. Echstine, of Pleyto, California. The deposit has not been investigated as yet, and its commercial value is unknown.

Heins Lake Deposit. Owner, Martha E. Bardin, Salinas, California. The bottom of Heins Lake, now dry, situated about 2 miles southeast of Salinas, is composed of blue clay. There is about 300 acres in the deposit, and it is said to average 4 feet in depth.

COAL.

The coal deposits in Monterey County are one of its chief mineral resources. The greater part of the coal output of the state during the past few years has come from this county, from the Stone Canyon Coal Mine. This mine ranks as the most developed and best equipped coal property in the state. Stone Canyon coal has been classed as a bituminous variety.[1]

As much of the coal in California is lignite, or of such low grade that it cannot be used to advantage as a steam coal, investigations have been under way in various quarters looking to a more economical method of utilizing the deposits. Research has taken the form of its possible utilization in the direct production of sponge iron and steel in the electric furnace. Others have investigated the low-temperature distillation process with the production of a semi-coke briquette, said to be an ideal smokeless domestic fuel, and various by-products. Experiments which give promise of success have been made to purify lignites and low-grade coals by some process such as the Trent method, which consists in agitating together powdered coal, water and oil. This produces a partly de-ashed plastic fuel called 'amalgam,' the oil selecting the coal particles and largely excluding the water and ash. In one experiment on a California lignite, the ash reduction amounted to 26.8%, the combustible recovery was 95%, and the sulphur reduction was 12% after treatment. Others have considered the manufacture of calcium carbide (CaC_2) from lime and lignite coal. Still other investigators have undertaken to show how these coals may be utilized in powdered form, either alone or with oil in 'collodial' fuels; to make them into briquettes without the use of an expensive binder; to manufacture producers gas from them; and to obtain for commercial use their other constituents, including ammonia, benzol, toluol, solvents, drugs, oils, and other coal tar products. All of these avenues offer possibilities which will doubtless attract the attention of capital before many years, and the coal deposits in Monterey County cannot fail to receive their share of attention.

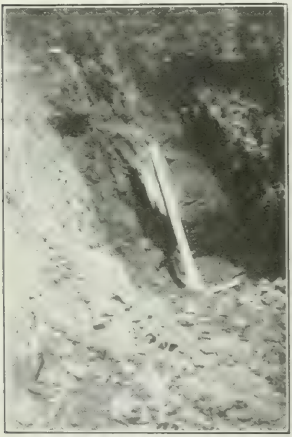
---

[1] Campbell, M. R., U. S. Geol. Survey Bull. 316, p. 435.

Bibl: Coal Resources of Monterey County. State Mineralogist's Reports VI, p. 117; VII, pp. 172, 178; VIII, p. 403; X, p. 347; XI, p. 259; XII, p. 59; XIII, p. 54; XV, p. 597; XVII, p. 156; XVIII, pp. 152-157; XIX, p. 26. Preliminary Report No. 8, pp. 9-10. U. S. Geol. Survey, Bull. 295, p. 223; 316, pp. 435-438; 431, p. 243; 521-d, p. 158; 585, p. 29. U. S. Geol. Survey Mineral Resources, 1909, p. 102. U. S. Bureau of Mines Bull. 22, pp. 53, 396; Bull. 38, p. 37. Univ. of California, Dept of Geology, Vol. I, p. 22.

Carmel Coal Mines. Situated about 14 miles south of Monterey and 2 miles from the coast at an elevation of 1000 feet. This property was a producer at one time, a tram way having been built from the mine to the beach. There was a double compartment shaft 275 feet deep, an incline and drifts. Three veins, 2, 4 and 6 feet thick, respectively were reported. Idle for many years. Owner, A. M. Allen, care Monterey Canning Co. Monterey, California.

Bibl: State Mineralogist's Reports VIII, p. 404; X, p. 347; XII, p. 54.



Typical outcrop, Priests Valley coal field.

Monterey Coal Co. A company by this name did considerable prospecting at one time on a bed of lignite in Priests Valley. A typical outcrop in the Priests Valley field is shown in the accompanying photo.

Bibl: Priests Valley. State Mineralogist's Reports VIII, p. 404; XII, pp. 59-60. U. S. Geol. Survey Bull. 581-d, pp. 158-160.

Stone Canyon Coal Mine. This property, which has had a somewhat interesting history since its discovery about 1870, is situated near the center of Sec. 14, T. 22 S., R. 13 E., M. D. M., at an elevation of 2748 feet.

After intermittent work by various operators, the mine was equipped at great expense and opened up on a large scale a short time previous to 1914 by the Stone Canyon Consolidated Coal Co., the product being shipped out by rail over a 21-mile spur track built from the mine to McKay, a station on the Southern Pacific Railroad, three miles north of San Miguel.

Heavy floods in January, 1914, washed out the railroad and destroyed the bridge over the Salinas River. This disaster, coming just at the time they expected to realize some returns on the investment, caused the mine to close down, and no effort was made to resume operations on a large scale.

In July, 1921, it was reported that the mine had been sold to eastern capitalists for $1,500,000. Work was commenced on the mine and railroad in the latter part of 1921, by a company headed by Mr. John H. Leavell. By September, 75 men were employed, and during the first half of 1922, there were 60 men working on top and about the same number underground. Operations continued during 1922 until after the middle of the year, the output being about 200 tons per day. It was reported that the coal had to be rehandled many times between the working face and the railroad cars, that mining costs were excessive, and that the mine could not be profitably operated unless at least 500 tons per day was produced. The output could not be raised to that figure, and the mine was again shut down.

In February, 1924, the Cal-Coal and Iron Co. was organized with an authorized capital of $3,500,000, for the purpose of purchasing and operating the Stone Canyon properties. A permit to sell $2,700,500 shares at par for this purpose was issued by the State Corporation Department. This effort to finance the property by popular stock subscription proved unsuccessful, however, and the attempt was given up. As a result, the property reverted to and remains under the ownership and control of the Stone Canyon Coal Co. and J. A. Chanslor, 509 Wells Fargo Bldg., 85 Second St., San Francisco. It comprises 2330 acres of patented land, 4600 acres under contract of purchase from the state; all equipment, together with 21½ miles of broad gauge railroad, and right of way and 14 acres of land at McKay Station. Reports filed with the Commissioner of Corporations place the amount of coal in sight at 3,899,000 tons, 80% recoverable; and a probable additional tonnage of 10,000,000 tons, of which 60% is regarded as recoverable. Not producing at present.

Bibl: State Mineralogist's Reports VII, p. 172; VIII, p. 403; XII, p. 59; XIII, p. 54; XV, p. 597; XVII, p. 156; XIX, p. 26. Preliminary Report No. 8, p. 9. U. S. Geol. Survey Bulls. 285, p. 223; 316, pp. 435-438; 431, p. 243; 581, p. 158. U. S. Geol. Survey Mineral Resources, 1909, p. 102. U. S. Bureau of Mines Bull, 22, pp. 53,396; Bull. 38, p. 37.

COPPER.

No copper deposits of importance have been developed in Monterey County, although native copper, malachite, chalcopyrite, and other copper minerals have been noted in minor amounts at a few localities.

Copper occurs as malachite in serpentine in Sec. 21, T. 23 S., R. 15 E., east of Parkfield. *L. E. Bedell*, of Parkfield, located some claims here, but nothing has ever been done with them.

Bibl: State Mineralogist's Report XV, p. 598.

Hammond Claims (see under Gold).

Native Copper Co., of Coalinga, at one time had a group of claims in Sec. 26, T. 23 S., R. 15 E., 7 miles east of Parkfield. Native copper was found there in serpentine. Nothing has been done recently, and they are probably abandoned.

Bibl: State Mineralogist's Report XV, p. 598.

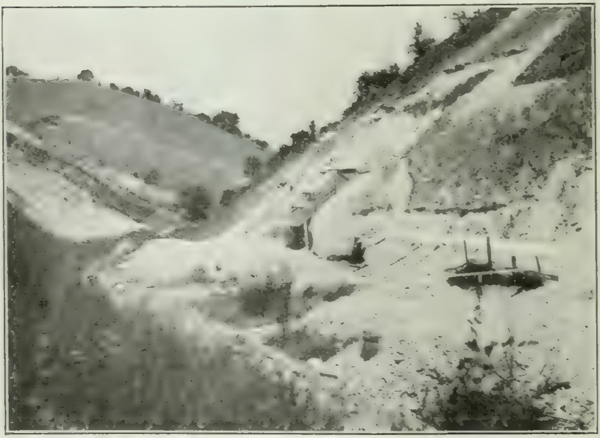
Riley Ranch Deposit (see under Arsenic).

DIATOMACEOUS EARTH.

A belt of diatomaceous earth runs along the eastern foothills of the Santa Lucia Range from the southern boundary of the county in T. 24 S., R. 10 E., in a northwesterly direction to Arroyo Seco in T. 19 S., R. 6 E. It shows again in Secs. 26 and 36, T. 15 S., R. 2 E. Most of the development has been in the area west of Bradley.

California Kieselguhr Co., Inc. Officers, John W. Work, president; W. I. Davis, vice president; Geo. C. Langley, secretary; F. B. Pendry, treasurer. Home office, San Miguel, California. The property of this company comprises 340 acres in Monterey County in Secs. 14 and 15, T. 24 S., R. 10 E., on the west side of the road between Bradley and Jolon. The surface is composed of fairly rugged hills, bare of timber, cut by a number of narrow canyons. Elevation at the principal workings, 1100 feet. Diatomaceous earth is exposed on about 75% of the area. The deposit was opened up in May, 1922, and the plant in San Miguel was started about six months later. It is 14 miles from the deposit to the mill. The crude earth is transported by motor truck and trailer in 10-ton lots, most of the haul being over the state highway with a good road from the deposit to the highway.

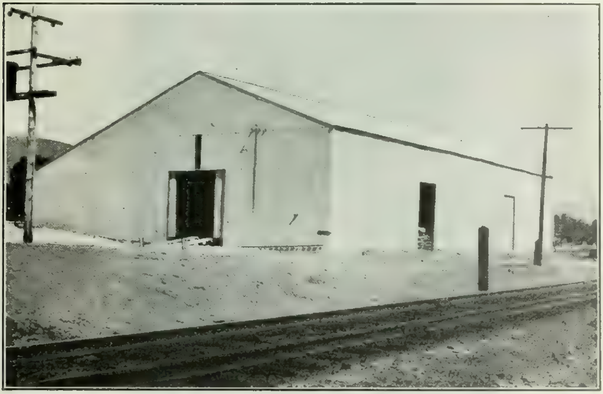
The deposit is being mined by both open cut, using pick and shovel, and by means of tunnels, drifts and stoping of the bed, which dips about 30°. There are 7 tunnels of varying length up to 150 feet. Low-grade material is mined in the open cuts, and high-grade by selection and underground stoping. Light shots are occasionally used in the stopes. By following this method it is possible for the company to produce a uniform high-grade earth when demanded.



Open cut and loading bin in Middle Canyon, California Keiselguhr Co., Inc., San Miguel, California.

Material from this deposit carries much less moisture than is usually found, and no artificial drying is required, it being possible to mine, mill, sack, and ship the earth within 8 hours.

The grinding plant is situated on the main line of the Southern Pacific Railroad in San Miguel, with a side track running through the center of the mill building. The crude earth is dumped from the trucks to bins and passes from the bins by a belt conveyor to a Williams hammer mill of 5-ton per hour capacity at 2100 r.p.m., driven by a 100-h.p. motor. A 45-inch Sturdevant fan draws off the discharge, which goes through a pipe, with traps for the heavier material, to a cyclone collector. The discharge from the first cyclone passes to a second cyclone, and then to the bag house for sacking and storage. The maximum capacity of the plant is 6 tons per hour. Operations have been intermittent, depending on demand. From 7 to 10 men are employed when operating.



Treatment plant of California Keiselguhr Co., Inc., at San Miguel, California.

Jens Deposit. Owned by J. C. Jens, 636 W. Adams St., Los Angeles. This deposit is on 120 acres of patented land in Sec. 20, T. 23 N., R 10 E., about 6 miles northwest of Bradley. Formerly operated by J. C. Jens, under the name of the Mineral Earths Supply Co. There has been no production the last two years.

Bibl: Report of the State Mineralogist, XV, p. 598.

Monterey Products Co. Incorporated October 4, 1923. C. A. Ryan, president; W. V. Buckner, vice president; T. Lee, secretary-treasurer. Office, Suite 37, Work Building, Monterey, California.

This company and its subsidiary, the Monterey Insulated Brick Co., Inc., with the same officers, controls 3900 acres under a 50-year lease, of which 100 acres cover a deposit of diatomaceous earth.

The deposit is a part of the old Saucito Rancho Grant, owned by T. A. Work. It is situated on the Salinas-Monterey highway four and one-half miles from Monterey. Shipments from Monterey can be made by either rail or water.

Monterey Products Company's Plant No. 1.

The exact extent of the deposit has not been definitely determined but it has been shown to extend over a considerable area. It is believed to have an average depth of 300 feet of soft diatomaceous earth and is roughly estimated to contain from 7 to 10 million tons. The material so far exposed is very pure. It is of marine or salt water origin, and is said to contain a large percentage of unbroken diatoms. The surface consists of rolling hills, partly covered with live oak. The elevation at the plant site is 160′ above sea level. Water is obtained from springs.

At the point where mining operations were begun there is no overburden, but in other places the diatomaceous earth is covered or partly covered by other formations. Mining is by the open-cut method in benches with pick and shovel. The material, as mined, is passed down a chute to the mill by gravity. The mill building and warehouse are of corrugated iron over a wooden frame, set on concrete foundations. Electric power, furnished by the Pacific Gas and Electric Co., is used throughout, there being a substation on the property.

At the bottom of the chute from the working face, the material is fed to a conveyer belt, which carries it to toothed rolls. From the rolls it is taken by bucket elevator to an oil-fired revolving dryer. A suction fan draws off the steam and air from the dryer, and this pipe is arranged so that the discharge may be passed through one or more, up to eight, cyclone separators, where the fine material carried over is collected. The coarse material from the dryer is elevated to two bins, each 20 feet square and 30 feet deep. From these bins the dried earth goes to a K-B hammer mill for pulverizing. An air blast picks up the discharge from the hammer mill and blows it through a pipe to a single long settling bin, the coarser material settling out first and the finer farthest from the pipe discharge. Excess air from this bin, carrying a very fine product, is passed through another cyclone where the very finest material is collected. Sacking devices are located at intervals under the long bin so that any grade desired may be sacked. After being placed in bags, the material is stored in the warehouse, which has a capacity of 20 cars of finished product. The capacity of the plant is 30 tons in 8 hours. The Monterey Products Company's output is sold under the trade name of 'Calatom' and is used for filtration purposes in the manufacture and refining of sugar, yeast, oils, and lard. It is used also in the making of dynamite, as a soap filler, as insulation in bake-ovens and boilers and in polishes.

Oakdale Ranch Deposit. This property, comprising 200 acres, is known as the Oakdale Ranch, address A. B. Ford, Pleyto, California, or C. D. Ford, 480 Twenty-fourth Street, Ogden, Utah, owners. It is situated in Sec. 18, T. 24 S., R. 9 E., M. D. M., about 2 miles from Pleyto on the Pleyto-Bryson Road, and 20 miles by good road from Bradley, the nearest railroad shipping point. Copperhead Canyon Creek furnishes a water supply the year round. Cream-colorerd diatomaceous earth of apparent high grade is exposed on the top and sides of 4 hills covering an area of 20 to 40 acres. There has been no work done except to take a few samples. An analysis follows:

Moisture (105° C.)	7.06%	
Analysis of moisture free sample.		Per cent
Silica SiO_2		83.61
Alumina Al_2O_3		4.70
Iron oxide Fe_2O_3		1.19
Calcium CaO		1.43
Magnesia MgO		.17
Soda and potash oxides R_2O		1.45
Titanium oxide TiO_2		.12
Manganese oxide		Trace
Sulphuric anhydride SO_3		None
Phosphoric anhydride P_2O_5		Trace
Sodium chloride NaCl		1.42
Combined waters and volatiles		5.81
Total		99.90

Analysis by Smith Emery & Co., San Francisco.

Pacific Diatom Products Co. Charles H. Pugh, Clarence A. Hunt, and Wm. H. Barker, of Berkeley, California, and Messrs. Poole and Clements, of San Miguel, California, directors. This company has a lease on the $N\frac{1}{2}$ of the $SE\frac{1}{4}$ and the $S\frac{1}{2}$ of the $NE\frac{1}{4}$ of Sec. 15, T. 24 S., R. 10 E., M. D. M., from the California Kieselguhr Co. on the F. Buttle property. They have contracted for 200,000 tons of diatomaceous earth in place, from the California Kieselguhr Co. on a royalty basis; the lessee to mine it. The Pacific Diatom Products Co. have erected a plant building in San Miguel, but the machinery has not as yet been installed and production has not begun.

Riewerts Deposit. This deposit is owned by B. J. Riewerts, 460 Jean street, Oakland, California. It is situated in Sec. 4, T. 24 S., R. 10 E. Intermittent shipments have been made since 1904. In 1923 it was under lease to W. C. Seccombe, 1120 Arrowhead avenue, San Bernardino, California, who made a small production.

Bibl: Cal. State Mining Bureau Bull. 38 p. 292.

DOLOMITE.

In a belt along the base of the foothills of the Gavilan Range near Natividad large deposits of dolomite have been developed. The belt crosses private ranches of various ownerships, and has been quarried at a number of points by different individuals. Operations have been carried on from time to time by H. Bardin, C. Z. Hebert, C. Patton, Robert Porter, Edward A. Taylor, and J. Braida, of Salinas. The most recent shipments have been made by O. D. Eastwood, from the Hebert property.

Webb and Mingus Deposit. E. A. Webb and S. M. Mingus, of Coalinga, own 160 acres in Sec. 28, T. 24 S., R. 16 E., containing a deposit of dolomite. It is about 8 miles east of Cholame. There has been no production.

FELDSPAR.

Jens Quarry. The deposit is on patented land owned by J. C. Jens, 636 W. Adams St., Los Angeles, in Sec. 34, T. 15 S., R. 5 E., about 5 miles east of Chualar. The haul is about 8 or 9 miles however, by way of the road up Chualar Canyon, from the deposit to the railroad. A large amount of high-grade feldspar has been shipped from this deposit in the past, but it has been nonproductive for a number of years.

Bibl: Report of the State Mineralogist, XV, p. 601; XVII, p. 156.

Johnson Bros. Deposit. Orthoclase feldspar is found on the ranch of Johnson Bros., Chualar, California. The deposit is located in Chualar Canyon, 5 miles east of Chualar and about one-half mile from the Jens deposit. Samples from the surface cropping show some iron oxide present. No work has been done on it, but it is probable that a good commercial grade of feldspar can be developed here.

GARNET.

A sample of massive garnet has been sent to the Bureau Laboratory by D. Smith, Chestnut street, Salinas, California. Garnets are common in the sands of the Los Burros district, and they have been noted at other localities, but the occurrence of a massive variety has not heretofore been recorded. It would be suitable for the manufacture of abrasives.

GOLD.

LOS BURROS DISTRICT.

The Los Burros Mining District is in the extreme southwestern part of Monterey County in T. 23 and 24 S., R. 5 E., M. D. M. It is best reached from the railroad at King City, by stage to Jolon and then by trail.

The first work in the district was in 1887 when W. D. Cruikshank discovered a small quartz vein carrying free gold. The discovery led to the development, on a considerable scale, of the Last Chance Mine, now owned by the Buclimo Mining Company. The property has been worked intermittently ever since.

Discoveries of placer gold in 1902 were made on Willow and Dogvine creeks and the Gorda and Plaskett mines were started. Placer work extended to all the nearby ravines.

From the years 1888 to 1915, inclusive, the district is estimated to have produced over $150,000 in gold.

Bibl: State Mineralogist's Reports VIII, pp. 405-410; XI, pp. 259-262; XII, p. 184; XIII, p. 234; XV, pp. 602-605; U. S. Geol. Survey Bull. 735, pp. 323-329; Mining and Scientific Press, Vol. 104, pp. 696-698, 1 fig., May 18, 1912.

GEOLOGY.

The following notes on the geology of the Los Burros district are quoted from the report of J. M. Hill[1].

> "The whole district is underlain by rocks of the Franciscan formation. No intrusive rocks other than the serpentinized basic dikes so characteristically associated with the Franciscan were noted, though intrusive granite occurs in the mountains at the headwaters of Nacimiento River. No attempt was made to map the irregularly distributed masses of serpentine, but there appear to be two more or less continuous belts or dikes, lying about 2000 feet apart and trending in a west-northwest direction, which run through the south-central part of the district. The most conspicuous exposures of the southern belt were noted along Spruce Creek, in the vicinity of the Gorda mine, and at the head of Alder Creek, near the Buclimo camp. The northern belt is well exposed along the south wall of the canyon of the South Fork of Willow Creek. The serpentinized rocks are almost completely altered, but a few specimens taken from the center of a particularly large outcrop indicate that the original rock was a peridotite.

---

[1] Hill, J. M., The Los Burros District, Monterey County, California. U. S. Geol. Survey Bull. 735-J, 1923.

> "The Franciscan formation as exposed here is made up of dark greenish-gray arkosic, micaceous sandstones, in general fine-grained but passing into fine conglomerates that are usually noted as lenses rather than as continuous beds. Although sandstone predominates, a large amount of the rock weathers like shale, because of the fineness of the constituent grains and the parallel distribution of the mica. The most abundant constituent of the sandstone is quartz, but orthoclase and plagioclase feldspar is only slightly less abundant. The dark color of the rocks is due to the unusual amount of hornblende and biotite. Near the serpentine areas the sandstone is altered to contorted schist, much crushed and sheared and cut by veinlets of quartz and calcite. In places in the vicinity of the basic dikes considerable bodies of massive sandstone have been thoroughly impregnated with minute crystals of garnet and pyrite.
>
> "All the rocks weather rusty brown, but there is a noticeable difference between the colors developed by weathering of the rocks in the deeper canyons and those near the summits of the ridges. The sandstone is massive, with little evidence of bedding, but weathers rapidly in small angular pieces that disintegrate readily into a brown sandy clay. The conglomerate lenses are usually composed of small rounded or egg-shaped pebbles of pinkish feldspar, white quartz, and black slate. In a few places, however, lenses of coarse arkosic sandstone, with small, flat, angular pieces of black slate, were noted. Only one small lens of radiolarian chert was seen; this lies at the head of Alder Creek a short distance from the New York mine.
>
> "There seem to be two rather distinct facies of the Franciscan formation in this district. The rock exposed in the lower parts of the canyon weathers in larger and more angular blocks of darker color than the overlying rocks that are exposed along the mail trail near the Buclimo mine and on the upper part of the ridge north of Willow Creek canyon. So far as known, serpentine does not occur in the overlying rocks. These upper rocks weather in small fragments, more like shales, though fresh exposures show that they are fine-grained sandstones, composed of essentially the same materials as the slightly coarser sandstones of the lower series.
>
> "The heavy growth of underbrush and the deep accumulations of broken rock and soil, even on steep slopes, make study of the structure very difficult. Practically all the readings taken on the west side of the summit gave strikes of N. 50°–70° W. and dips of 20°–60° NE. East of the summit the strike is more nearly N. 45° and the dip 65°–70° NE. It is judged that this particular part of the Santa Lucia Range is a monoclinal tilted block, lying between a fault whose escarpment forms the northeastward-facing wall along Nacimiento River and another fault represented by the scarp along the coast. These faults trend approximately N. 40° W. The trace of a major fault trending N. 70° W. is indicated by a series of benches and depressions on the south wall of the South Fork of Willow Canyon, about midway between the two larger serpentine dikes. The structure is probably complex in detail, for much evidence of minor movement, both parallel to and across the general structure lines, is seen in every exposure."

MINES.

Most of the properties in this district have been active during short and irregular periods only. Abandonments and relocations of claims with a change of names have been common and it is difficult to give a connected account of the operations at any of the mines. The most recent and important developments have taken place at the New York Mine. Development work is going on at the present time (January, 1925), at the New York, Mariposa and Oregon Mines, but practically all the others are idle.

Brewery Mine. S. O. Pugh, owner, Soledad, California. This property is located in Sec. 2, T. 24 S., R. 5 W. The gold is free in a quartz vein in 'slate,' and is said to average about $8.00 per ton. Referring to this property, at the time of his visit, Hill[2] says:

> "The Brewery tunnels are north of the trail, about 200 feet down the slope toward Willow Creek from the mail-trail ridge and 1 mile west of Melville's cabin. They were caved at the time of visit, but apparently were run on a ledge that strikes N. 80° W. and in the cuts dips 60° S. As exposed in the cuts, the ledge matter is 6 feet wide and consists of fine-grained black sandstone, with veinlets of quartz and a little siderite. No sulphides were seen on the dump, but small casts of cubical outline filled with limonite indicate that the mineralization is similar to that on the Buclimo."

Bibl: State Mineralogist's Reports VIII, p. 409; XV, p. 603.

Brooklyn Mine. Owner, James H. McNeil, Dutton Hotel, Jolon, California. This property consists of one claim, situated in Sec. 2, T. 24 S., R. 5 E., M. D. M., and lying parallel to the New York Mine. Development has all been by open cuts. These have exposed a lode, containing quartz stringer veins, carrying free gold, rich in places. The country rock is slate and sandstone. Idle.

---

[2] Hill, J. M., *idem*, p. 328.

Buclimo Mining Co. Address 709 Balboa Building, San Francisco; Dr. C. A. Clinton, Twenty-first and Howard streets, San Francisco, president. This property has not been operated since the period of the world war. The Buclimo is located in Sec. 2, T. 24 S., R. 5 W., M. D. M., at an elevation of about 2800 feet. It includes the Last Chance, East Extension No. 1, West Extension No. 1, Mary S., Mary S. Extension, Gold Gulch Nos. 2, 4, and 5, Good Gold, Flat View (camp site), Ora F. Nos. 1 and 2, Rankin, Perry, Lucky Jim, and Pansy Fraction. It was visited by J. M. Hill[3] in 1921, who says:

"The Buclimo (Last Chance) workings were not accessible. From the surface work it is judged that at least four nearly parallel lodes exist on the property. These strike N. 80° W., and, to judge from the northerly dips at the surface, the ledges may come together with depth. It is said that from the surface to the tunnel level, 85 feet below, the lode has been stoped for a width of 10 feet and a length of 500 feet. A little ore presumably from the tunnel level, found in a mill bin, showed quartz-calcite veinlets, with pyrite and arsenopyrite in crushed, somewhat mineralized dark-colored sandstone and shale. The upper workings are reported to be abandoned now, and a long crosscut tunnel has been started from the level of Alder Creek, near the Grizzley incline. This crosscut is more than 1800 feet long, but has not reached the vein. It was run in a direction almost parallel to the vein and the strike of the sandstone beds. The first 200 feet of the crosscut is in medium-coarse sandstone; next there is 100 feet of black chert; and the remainder of the tunnel is in nearly black sandstone that is almost fine grained enough to be termed slate. This tunnel shows the formations to be very much broken and faulted, most of the movement being parallel to the bedding in dip as well as in strike, but with many planes of minor movement showing parallel strike but much steeper dip than the bedding."

The Buclimo is equipped with a 5-foot Huntington Mill, Frue concentrator and accessories. The mine has been idle since about 1917. The president of the company was expected on a visit to the property in January, 1925, which may indicate a renewal of activities.

Bibl: State Mineralogist's Reports VIII, p. 405; XI, p. 261; XII, p. 184; XIII, p. 234; XV, pp. 603-604.

Bushnell Mine. This property has not been mentioned in our earlier reports, and the following notes are from the paper of J. M. Hill[4], who visited the property in 1921.

"The Bushnell property is on the point between the Middle and North Forks of Willow Creek. The developments consist of an inclined shaft and a crosscut tunnel, 330 feet in all. The incline is sunk 130 feet on the intersection of a north-south fracture that dips 50° E. and a N. 50° E. stringer that dips 50° SE. It is reported that about $9,000 in free gold was milled from the ore obtained in sinking this shaft. At the tunnel level the north-south fracture is barren; the N. 50° E. fissure ranges in thickness from a knife-edge to 8 inches and is filled with white quartz, calcite and fragments of wall rock, the whole much crushed and shattered. A little free gold is visible in some of the quartz, but no sulphides, limonite, or other indications of the former presence of sulphides were noted in the ore."

Gorda Mine. Owned by the Gorda Gold Mining Co. Mr. George Reed, manager, Gorda, California. This property is located on Spruce Creek in Sec. 4, T. 24 S., R. 5 E., at an elevation of 2000 feet. In describing it at the time of his visit in 1921, Hill[5] states:

"In 1902 several exceptionally large rugged gold nuggets were found in the stream bed nearby. Considerable money was spent in equipping the property for hydraulic work, and a little more gold was obtained. The talus and soil cover, however, were so deep that the stream gravels had not been reached except over a short distance. A number of tunnels have also been run in talus to locate the rim of the covered channel, and some work has been done in the sandstone on the north wall of the gulch in the hope of discovering the source of the coarse gold, but this object had not been reached in 1921. The sandstone cut by this tunnel is peculiar in that it contains small flat fragments of black slate, minute red garnets, and a small amount of finely disseminated pyrite. The mineralization is localized in the sandstone within 150 feet of a considerable outcrop of serpentine."

The mine is idle at the present time (January, 1925).

Bibl: State Mineralogist's Report XV, p. 604.

---

[3] Idem, p. 327.
[4] Hill, J. M., U. S. Geol. Survey Bull. 735, p. 329.
[5] Hill, J. M., U. S. Geol. Survey Bull, 735, p. 328.

Hammond Claims. There is no data on this property, under the above name, in former reports of the Bureau. J. M. Hill,[6] however, refers to it in his report on the Los Burros district in the following words:

> "In the canyon of the South Fork of Willow Creek, F. C. Hammond has several prospects on N. 80° W. zones of mineralization in the slates and sandstones. The metalliferous minerals here consist largely of disseminated pyrite and chalcopyrite in hard dark-colored sandstone along a series of nearly vertical tight fractures. No arsenopyrite was noted. There is practically no oxidation on any of the ledges, though a little iron and copper stain is to be seen directly on the surface. At one of Mr. Hammond's claims, on the ridge between South Fork and Willow Creek, pyrite and a little chalcopyrite are disseminated along a shear zone in garnetized sandstone about 25 feet from a lens of serpentine. Very minor amounts of copper silicate and limonite coat the joints at the surface."

Manchester. (*Blue Jay*), owned by S. O. Pugh, Gorda, California. Idle.

Bibl: State Mineralogist's Report VIII, p. 407; XV, p. 605.

Mariposa Mine. This mine is located in Sec. 2, T. 24 S., R. 5 E., at an elevation of approximately 2700 feet. It is near Spruce Creek and includes the following claims: Blue Jay Nos. 1 and 2, San Lucas, Protection, and McKinley. The gold occurs free in quartz ledge which carries some arsenopyrite. In January, 1925, a crosscut tunnel was being driven to cut the vein. Three men were working.

Bibl: State Mineralogist's Report XV, p. 605.

M. M. Mine (*Melville*). This property consists of 22 claims, owned by H. F. Melville, Palisade and Pinnacles, via Soledad, California. They are situated on Gold Ridge between two forks of Willow Creek, and appear to be a continuation of the Buclimo lode. A large open cut below the trail exposes a crushed ore zone, containing stringers of quartz, and having a width of 10 feet or more. The entire crushed zone is said to carry some gold. A rough concentration by panning showed the presence of pyrite and arsenopyrite.

Bibl: State Mineralogist's Reports VIII, p. 408.

New York Mine. Owner, New York Mining Co., a private company, composed of Wm. Cruikshank, John Harboldt, Jas. Trickle; and Donald and J. C. Lazier, of Gonzales, California. The New York was discovered by a man named McCormick about 1904. It is located in Sec. 1, T. 24 S., R. 5 E., on Ajax Mountain. J. M. Hill[7] at the time of his visit (1921) states:

> "At the New York property, on Ajax Mountain near the summit, two narrow veinlets, about 18 inches apart, constitute the lode. The crushed, contorted rocks between the veinlets carry pyrite and arsenopyrite, with very minor amounts of chalcopyrite and galena. Complete oxidation on this lode has extended to a depth of 50 feet and mining to that depth has yielded some fairly good free-gold ore. Two tunnels, a few hundred feet in total length, have been driven in the sulphide zone. The sulphides are in very small crystals and appear to have been deposited subsequently to a period of crushing of the original quartz veins. Arsenopyrite predominates over pyrite."

Development has continued since the above was written. A lower crosscut tunnel, 200′ below the outcrop, has been driven 440 feet, at which points it cuts a vein 3 to 4 feet in width, carrying good values over a width of 20 inches to 3 feet or more. There are 12,000 to 15,000 tons of the ore on the dump ready for milling. A Straub mill with amalgamating plate and Overstrom table, driven by gas engine, had just been installed (January, 1925), and preparations were being made to start milling. In the lower level nearly, if not all, the values are in the form of sulphides, which carry very little silver. The concentrates will be packed out over the trail to Jolon. A new coast road from the south has been built as far as Salmon Creek, and if this is extended as contemplated, it will aid greatly in the development of this and other properties.

---

[6] Hill, J. M., U. S. Geol. Survey Bull. 735, p. 328.
[7] Idem, p. 327.

Oregon Mine. This property adjoins the Mariposa and consists of the Oregon and Cool Springs claims. It is in Sec. 2, T. 24 S., R. 5 W., at an elevation of 2700 feet. J. M. Krenkel, owner, Gorda, California. The gold occurs free in a quartz ledge which contains some hematite near the surface. Considerable work has been done in the course of assessments, and Krenkel and his sons were continuing development in January, 1925.

Bibl: State Mineralogist's Report XV, p. 605.

Plaskett Mine. (*Ocean View;* also known at one time as *Howard Mine.*) L. M. Plaskett, owner, Gorda, California. The mine is located in Sec. 30, T. 23 S., R. 5 E., at an elevation of about 900 feet. It was formerly under lease to W. C. Howard, of San Francisco, and was equipped with a 3½-foot Huntington Mill run by a gas engine. Development since our previous report was noted by Hill[8] in 1921, who says:

> "It is developed by an 86-foot incline, with short drifts to the northwest at 40 and 80 feet and a 100-foot drift tunnel to the southeast on the 40-foot level. The ledge strikes N. 45° W. and dips 10° NE., at the surface but steepens to 60° at the bottom of the incline. It consists of crushed white quartz, slightly iron strained but with no visible sulphides. It is reported that $18,000 in free gold was recovered from float picked up below the croppings and from ore obtained in sinking the incline. It is judged that the free gold occurred in a small lens, for the quartz exposed in the workings appears to be barren."

Idle in January, 1925.

Bibl: State Mineralogist's Report XV, p. 605.

Sandall Property. There are two claims in this property, the Gold Ore No. 2 and the Helen Davis. Mrs. John A. Sandall, owner, 3674 Sixteenth street, San Francisco. They are located in Sec. 35, T. 23 S., R. 5 E. A tunnel 67 feet in length on the Gold Ore No. 2 cut a small vein carrying free gold. Assessment work only is being done.

NEW LOCATIONS.

Recent locations in the Los Burros district include the Fighting Bob No. 1, on the north side of North Fork Dog Vine Creek, formerly the Good Brothers claim. Abel A. Collins, 336 Monterey street, Salinas, California, owner.

Philip Krieger has recently located the Evergreen Placer and the Brown Eagle Nos. 1, 2 and 3, quartz claims.

JOLON DISTRICT.

The *Ruby Placer Mine* is located about three miles northwest of Jolon, on the Milpitas rancho in Old Man's Cañon. It is owned by Messrs. H. and W. T. Hess of San Francisco.

In the spring of 1914 the Hess Brothers installed a hoist with dragline bucket. Water was obtained from dams in the cañons where winter flood waters were held. The gravel was washed through a rotary tube screen run by a gas engine. Several experiments were made and although it is said the color in the pan ran as high as 50 cents per cubic yard, the recovery with the screen and riffle board was too poor to make it a paying proposition. There has been no recent attempt to work this property.

---

[8] Hill, J. M., U. S. Geol. Survey Bull. 735-J, p. 329.

Bibl: State Mineralogist's Reports VIII, p. 405; XV, p. 606.

PARKFIELD DISTRICT.

On the *Cholame Grant*, 7 miles southeast of Parkfield, there is a series of gulches with gravel deposits which have yielded some placer gold. It is locally known as 'Gold Hill.'

Summary.

Gold in Monterey County is found in quartz veins in the metamorphic rocks and as placer gold in Pleistocene gravels. Gold in the quartz veins is free milling down to the water level and rich pockets have been found. The veins are narrow, however, and considerable wall rock must be worked. Below the water level, which is usually about 150 feet below the surface, sulphides are encountered. The value of these sulphides has not been fully ascertained but some specimens examined showed no secondary enrichment.

Placer gold has been obtained both from raised beaches along the west coast and from loose raised gravel deposits west of Jolon. Deposits of considerable extent remain which only await a profitable method for extraction.

LIMESTONE and MARBLE.

A belt of limestone shows in several places on the west slope of the Santa Lucia Range, not far from the coast line. It outcrops in the north on Long Ridge in Sec. 9, T. 18 S., R. 1 E., and runs in a southern direction to Sec. 36 of the same township, and Sec. 31, T. 18 S., R. 2 E. It is prominently exposed on Pico Blanco in Sec. 36. Deposits of possible economic importance occur on the ranch of Mr. John Little of Monterey, south of Point Sur; and on the 640-acre ranch of Mrs. C. L. Koch of Pacific Grove, in Sec. 36, T. 18 S., R. 1 E., which includes in part the deposit on Pico Blanco. A landing place suitable for shipping from the latter deposit is said to exist north of Point Sur and 5 miles from Pico Blanco. Burned lime was at one time produced from a quarry in Sec. 16, T. 18 S., R. 1 E. A conspicuous outcrop also occurs on Sec. 30, T. 19 S., R. 3 E. Farther down the coast burned lime has been produced from deposits in Sec. 22, T. 22 S., R. 4 E. Notable deposits of limestone, often crystalline, are likewise found at various points in the Gavilan Range in this county. An undeveloped deposit of white marble is reported in Sec. 6, T. 23 S., R. 14 E., near Parkfield.

Bibl: State Mineralogist's Reports IV, p. 110; VI, pp. 29, 97; VIII, p. 410; XI, p. 260; XII, p. 392; XIII, p. 629; XV, pp. 599, 606; Bull. No. 38, pp. 72, 73.

Alisal Ranch Deposit. Owners, Martha E. Bardin, Hazel J. Hurt, and Ethel O. Tholcke, all of Salinas. This deposit, a little north of east and about 7 miles distant from Salinas in the foothills of the Gavilan Range, lies at an elevation of about 700 feet. In former years the narrow gauge railroad of the Spreckels Sugar Co. extended to it, and most of the limestone produced has been used by the Spreckels Co. A portion of the track has been taken up so that the deposit is now

1¼ miles from the end of the road. The limestone is massive, but not suited for technical use in sugar making, as carried out in the Spreckels plant in recent years, and there has been no production for about 15 years.

Kellogg Ranch Deposit. A similar deposit, owned by the same parties as the Alisal Ranch deposit, is located farther southeast and about 16 miles from Salinas. Limestone of similar quality found here was also used by the Spreckels plant at one time. The deposits are very large and their accessibility to railroad, location adjacent to the clay deposit at Heins Lake, and their relative closeness to gypsum deposits near King City, offer possibilities for the establishment of a cement industry. A pumping station and the oil pipe line of the Associated Oil Co. is located about 2 miles south of Salinas.

Los Vergeles Ranch Deposit. This deposit is situated on Lots 1 and 3 of the Los Vergeles Rancho. The property has an area of 250 acres, and is owned by the Commercial Lime Co., Henry A. Schulze, president, 5163 Eagle Rock Blvd., Los Angeles; Burke Corbet, First National Bank Bldg., San Francisco, secretary. Dr. J. H. Wythe, 418 Consolidated Bldg., Hill and 6th Streets, Los Angeles, who discovered the deposit and owned 2500 acres of the Spanish Grant land upon which it was found, sold it to the above company, in which he holds a controlling interest.

The deposit is about 12 miles northeast of Salinas on the state highway running from Salinas to San Juan. The highway cuts across the face of two exposures, covering 43 acres, and passes between two other large deposits 2½ miles from the former, on the remaining 207 acres.

The greater portion of the limestone lies above the highway and can be brought to it with the aid of gravity. A tunnel (closed) was placed under the highway at the time of its construction, and the right of way deed provides for the working of the deposit through this tunnel so there can be no interference with quarry operations.

A power line crosses the land, and the Associated Oil pipe-line and pumping station is located within about 14 miles.

The limestone ranges from a coarsely crystalline white and bluish-white calcite to a very compact holocrystalline, fine-grained marble. It averages very high in lime content. Some of this limestone has been used by the Judson Iron Works, but production to date has been limited.

Bibl: Cal. State Mining Bureau Bull. 38, p. 73.

MAGNESITE.

Nevins Magnesite Deposit. F. M. Nevins, P. O. Box 545, Coalinga, California, owner. This holding comprises 80 acres in Sec. 29, T. 23 S., R. 15 E., M. D. M., about 4 miles east of Parkfield, near Table Mountain. There is a deposit here of undetermined extent, it having been prospected only slightly by open cuts.

An analysis of the magnesite follows:

	Per cent
SiO_2	1.12
Al_2O_3	.14
Fe_2O_3	.11
CaO	1.46
MgO	45.70
Loss	51.40
Total	99.93

Purity as magnesium carbonate, 95.56%.

A little farther along magnesite also shows in Secs. 34 and 35, T. 23 S., R. 15 E., at the base of Table Mountain.

MINERAL WATER.

Monterey Mineral Well. This property is owned by O. P. Colburn, 622 Spencer street, New Monterey, California. The well was formerly known as O'Connor Mineral Spring, although it is a well, originally dug by O'Connor. The present owner bought the property in July, 1923, and has provided bathing facilities and established an auto camp ground in connection. The well is 50 feet deep, and 25 feet of water stands in it at all times. The water is pumped to a tank by a small pump, operated by electric motor; the tank supplying the baths, either hot or cold, and the bottling department. It is bottled, both as it comes from the well and artificially carbonated. It is said to be of particular benefit in the treatment of rheumatism, kidney, and stomach disorders. An analysis by E. J. Lea, Director of the State Laboratory, is reported as follows:

Open cut, Nevins' magnesite deposit.

Analysis.

Analysis of the water from Monterey Mineral Well, as made by E. J. Lea, Director of the State Laboratory:

	Gms. per 100 cc.
Total solids	.585
Loss on ignition	.050
Iron, alumina and phosphoric acid	.002
Magnesium oxide	.035
Chloride	.240
Silica	.085
Calcium oxide	.031
Sulphate SO_4	.020

Phosphoric acid, traces only.

SPRINGS.

The following data on the mineral springs of Monterey County, with the exception of a few notes regarding their ownership and accommodations for the public, are taken from the U. S. Geological Survey Water Supply Paper No. 338, 'Springs of California,' by Gerald A. Waring, 1915.

"*Banes Soda Springs.* Banes Soda Springs are situated on the coast about 6 miles southwest of the Cruikshank (Buclimo Mining Co.) Mines. Carbonated water issues for a considerable distance along a bluff that here borders the ocean and has deposited notable amounts of lime carbonate. At the main spring a terrace several feet in height has been built by the iron stained material that has been deposited from solution.

"The water apparently derives its contents of calcium and of carbon dioxide from limestone masses that are associated with the other altered sediments along this portion of the coast."

"*Dolan's Hot Spring.* A warm and mildly sulphureted spring exists on North Fork of Big Creek, about 1½ miles from the ocean and 7 miles by trail south of Slate's Hot Springs. The water issues in a deep portion of the cañon, which is heavily timbered with redwoods, and as the place is known only locally and is not easily accessible, the spring has not been made use of and has seldom been visited." Philip Dolan, owner.

"*Helms Soda Springs.* Helms Soda Springs are about 3 miles east of Banes Soda Springs. Their water is strongly carbonated, but the flow is slight, and they have not formed a notable deposit such as is found at the springs farther west."

"*Hot Springs on North Fork of Little Sur River.* Several thermal springs rise in the bed and along the banks of North Fork of Little Sur River, about two miles above the point at which the stage road crosses the stream. The springs in the stream bed form a warm pool, and on its right bank two or three flows, having a maximum temperature of 114°, issue from crevices in the rock and fill a small natural basin. The springs are in a narrow, rugged section of the stream cañon, in a granitic area, and possibly rise along fractures that have been produced by local faulting. The water is mildly sulphureted but it is not otherwise noticeably mineralized. A considerable amount of fibrous algous growth, from white to reddish purple in color, is found in the stream and the adjacent pools.

"During the nineties the water was piped to a grove of redwoods in a flat some distance below the springs, and it was the intention to build a hotel and bathhouse. High water washed out the pipe line, however, and in 1908 the attempt to develop the springs had not yet been renewed." J. and Annabel Brown, Salinas, California, owners.

"*Paraiso Hot Springs.* Paraiso Hot Springs are situated near the head of a small valley that opens eastward to Salinas Valley. Underground water lies at a shallow depth near the springs, beneath an area of several acres within which at least five mineral springs rise. The largest of these, which is known as the Soda Spring, has an observed temperature of 111°, and a discharge of perhaps 8 gallons a minute.

About 40 yards away two small Sulphur Springs rise with temperatures of 88° and 102°, and 100 yards farther east there are two drinking springs each of which yields perhaps one-fourth gallon a minute. These are known as the Iron Spring and the Arsenic Spring and have temperatures respectively of 68° and 65° F.

"The springs at this place were known to the Catholic Mission Fathers, who at one time lived here. Their extensive modern use dates back more than 20 years, and their accessibility has made them an objective point for automobile parties. In 1908 accommodations were provided in hotels and cottages for about 200 guests, while tub and plunge baths at the Soda and the Sulphur springs, and a swimming plunge that was also supplied by these springs, gave ample opportunity for use of the waters. Analyses of the springs, made a number of years ago, are available and are here presented in the standard form.

Analyses of Water from Paraiso Hot Springs, Monterey County, California.

(Constituents are in parts per million.)

	1	2	3	4	5
Temperature	48°C. (118°F.)	48°C. (118°F.)	46°C. (114°F.)	21°C. (70°F.)	21°C. (70°F.)
Properties of reaction:					
Primary salinity	81	85	69	51	82
Secondary salinity	2	0	10	0	17
Persalinity	0	0	0	0	1
Primary alkalinity	0	2	0	11	0
Secondary alkalinity	17	13	21	38	0
Subalkalinity	22	12	39	28	51

Constituents	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By wighte	Reacting values
Sodium (Na)	253	11.00	252	10.96	233	10.13	234	10.18	179	7.78
Potassium (K)	2.9	.07	3.1	.08	6.4	.16	80	2.05	58	1.48
Calcium (Ca)	41	2.04	32	1.60	28	1.40	30	1.50	23	1.15
Magnesium (Mg)	7.5	.62	------	------	38	3.13	74	6.09	9.8	.81
Iron (Fe)	7.3	.26	19	.68	9.7	.35	12	.43	3.9	.14
Aluminum (Al)	5.1	.56								
Sulphate (SO₄)	493	10.27	463	9.64	520	10.83	23	.48	22	.46
Chloride (Cl)	38	1.07	39	1.10	29	.82	342	9.65	387	10.92
Carbonate (CO₃)	79	2.63	56	1.87	94	3.13	304	10.13	------	------
Arsenate (AsO₄)	------	------	------	------	------	------	Trace	Trace	------	------
Silica (SiO_2)	50	1.66	45	1.49	44	1.46	156	5.18	176	5.84
Totals	977	------	917	------	1,002	------	1,255	------	859	------
Carbon dioxide (CO_2)	25	1.14	(a)	------	17	.77	(a)	------	------	------
Hydrogen sulphide (H_2S)	------	------	------	------	60	3.52	------	------	------	------

(a) Present.
1. Hot soda spring. Analyst and authority, Winslow Anderson, 1889.
2. Hot soda spring. Analyst, A. Cihi, 1871. Authority, U. S. Geol. Survey Bull. 32.
3. Hot sulphur spring. Analyst and authority, Winslow Anderson, 1889.
4. Arsenic spring. Analyst, A. Cihi. Authority, advertising matter.
5. Iron spring No. 2. Analyst, A. Cihi. Authority, advertising matter.

"The Hot Soda Spring is primarily saline in character with secondary alkalinity as a subdominant property. The term "soda," usually referring to primary alkaline waters, is a misnomer. The Hot Sulphur Spring differs from the Hot Soda Spring chiefly by reason of higher secondary salinity and its content of hydrogen sulphide. The analyses of the Arsenic and Iron springs are of doubtful authenticity. It is of interest that only a trace of arsenic was found in the Arsenic Spring and very little iron in the Iron Spring. Both have primary salinity for the principal property. High magnesium with respect to calcium is indicated for the Hot Sulphur and Arsenic springs.

"The hills on each side of the little valley at Paraiso Springs consists of gravelly sandstone that dips gently away from Salinas Valley. Granitic boulders scattered along the ravines indicate that crystalline rocks are exposed to the west. Although a fault is mapped through Salinas Valley, it is not believed that such structure has given rise to Paraiso Springs. It seems more probable that some local fold or bedrock obstruction here forces underground water to the surface, and that its thermal character may be due to the depth from which it rises, in a locality of unusually high temperature gradient."

Paraiso Hot Springs is situated at an elevation of 1400′, and is easily reached, being only 7½ miles from Soledad. The resort is open the year round, and it is one of the popular mineral spring resorts of the state. O. B. Peterson is owner-manager, Paraiso Springs, California.

"*Slate's Hot Springs.* In the Coast Ranges of Monterey County thermal springs of note issue at four places. The southernmost of these is at Slate's Hot Springs, on Mr. J. A. Little's ranch. The water here issues at ten principal points in a distance of 125 yards, halfway up the face of the bluffs that here border the ocean. A small private bathhouse has been built near the easternmost spring. The waters range in temperature from 110° to 121° F., are mildly sulphureted, and the run-off streams are lined with abundant green algous growth. Small deposits of alum, gypsum, and carbonate of lime or magnesia were noted at the edge of one spring. The waters taste distinctly sweetish.

"About one-fourth mile northwest of the main group, on the left bank of Hot Creek, is another spring, 98° in temperature. This spring yields perhaps 5 gallons a minute and is used for laundering clothes.

"It is said that the location of the springs was described by an Indian to Mr. Thomas B. Slate, who made his way southward with difficulty along the steep, brushy slopes, and succeeded in finding only the warm spring beside the creek. Later, however, he came down the coast in a boat, found the springs on the bluff, and settled near them in 1868.

"*Sulphur Spring on Mission Creek.* About 12 miles west of north from Jolon post office, or 10 miles from San Antonio Mission, there is a cool sulphur spring that has been used to a slight extent as a drinking spring. It is not near a main traveled road, however, and is not widely known. The spring apparently issues from sedimentary materials, probably of Tertiary age, that form the hills bordering the west side of Salinas Valley. It is on the Milpitas Rancho."

"*Tassajara Hot Springs.* A large amount of hot water issues at Tassajara Hot Springs, which are in the cañon of Arroyo Seco, in the southern part of Monterey County. About seventeen thermal springs may be counted here, in the bed of the creek and along its southern bank. They range in temperature from about 100° to 140° and from mere seepages to flows of seven or eight gallons a minute.

"The thermal waters issue from a gneiss that is exposed along the creek for a distance of 200 yards or more. Above and below this exposure the rock is granitic and in some places contains small garnets. The crystalline rocks are overlain by a series of shale, sandstone, and limestone, whose structure in the area north of Arroyo Seco is well shown by the beds of massive buff-colored sandstone that dip northeastward at an angle of about 45°. A western limb of this structure was not seen, though it may exist in the mountains farther coastward. The observed dips at least suggest that Tassajara Hot Springs issue at a locality where Arroyo Seco crosses a zone of intense pressure in the crystalline rocks.

"The springs received their name from an Indian or Mexican word that means 'the place where meat is cured by drying,' and dates from the early days of the cattle industry. The springs have thus been known and used for many years, and they were early visited by campers, when the only access was by means of a difficult trail. Several years ago a well-graded wagon road was built southward from Jamesburg across the mountains and down into the cañon, and the springs are now easily reached by stage. In 1904 a stone hotel was built, and other improvements have been added yearly, so that in 1909 there were ample accommodations for 75 people, though a larger number has been taken care of by the use of tents. Water from two of the largest springs has been piped to tub and plunge baths, and a vapor bath has been constructed over the hottest spring, which issues in the creek bed.

"Analyses of two of the thermal waters were made. These waters are noticeably sulphureted, and the analyses show them to be only moderately mineralized. The water of the arsenic spring has a distinctly yellow color, which in a few other springs has been ascribed to alkaline sulphides in solution.

"At the north edge of the creek, a few yards above the hot springs, there are two cool springs in which iron is deposited. An analysis of the easternmost of these springs is tabulated with the hot springs.

Analyses of Water from Tassajara Hot Springs, Monterey County, California.

(Analyst and authority, F. M. Eaton, 1909. Constituents are in parts per million.)

	1	2	3
Temperature	59°C. (138°F.)	39°C. (103°F.)	18°C. (64 F.)
Properties of reaction:			
Primary salinity	63	65	19
Secondary salinity	0	0	16
Persalinity	0	0	0
Primary alkalinity	30	26	0
Secondary alkalinity	7	9	65
Subalkalinity	138	104	--------

Constituents	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	81	3.51	75	3.26	14	0.59
Potassium (K)	4.6	.12	4.8	.12		
Calcium (Ca)	5.3	.27	4.0	.20	33	1.64
Magnesium (Mg)	Trace	Trace	1.3	.11	11	.87
Iron (Fe)	1.5	.05	2.0	.07	0.8	.03
Aluminum (Al)					1.9	.21
Sulphate (SO_4)	110	2.29	109	2.27	36	.75
Chloride (Cl)	6.5	.18	5.0	.14	12	.32
Carbonate (CO_3)	41	1.37	38	1.28	61	2.03
Arsenate (AsO_4)	--------	--------	(a) 0	.00	--------	--------
Silica (SiO_2)	118	3.90	116	3.84	(?)	--------
Totals	368	--------	375	--------	170	--------
Carbon dioxide (CO_2)	0	.00	0	.00	(b)	--------
Hydrogen sulphide (H_2S)	25	1.47	(b)	--------	(?)	--------

(a) Not detected in 1 liter of water. (b) Present.

1. Lower of two main basins. 2. Arsenic spring. 3. Iron spring.

The two hot springs were apparently from the same general source, showing only slight difference in composition. Primary salinity and primary alkalinity are the chief stable properties, but the waters are characterized by high tertiary alkalinity, of which silica is the chief component. The carbonate radicle reported is presumably calculated from the alkalinity determination and doubtless includes sulphides and possibly silicates. The apparent absence of arsenic in the so-called arsenic spring is noteworthy.

"The iron spring is of markedly different character from the hot springs, being less than half as concentrated and having secondary alkalinity as the dominant property. Tertiary alkalinity is not reported, but this property is probably relatively low. It is probably of essentially surface origin, and not directly related to the thermal waters.

"The following notes concerning algous growths in the creek below the hot springs are here given, as the growths are related to the sulphureted character of the water. Although they are common to thermal sulphur springs, the relatively large volume of water in the creek at Tassajara Hot Springs, its comparatively slow cooling, and the presence of both swift currents and of quiet pools, affords an unusually good opportunity to observe the variation in character of the growth.

"At the main springs, where the temperature of the water was 110° to 140°, the material was mainly fibrous, and white, green, and reddish-brown in color.

"About 75 yards below, at a temperature of 96°, there was a dark green layer on the bottom of pools, with a small amount of white material on the surface of the green. Where the current was swiftest a purple-brown, furry growth, one-eighth to one-quarter inch thick, covered the rocks.

"At 125 yards, where the temperature was 91°, a green, leathery growth covered portions of the bottom, with white, feathery streamers attached to it where the current was rapid.

"At 200 yards, in a temperature of 87°, a thick, leathery growth coated the entire stream channel, being green and white on its upper surface, pale purplish-red inside, and black on the under surface. A number of pale purple, feathery, and white threadlike streamers extended from it.

"At 250 yards, in a temperature of 83°, there was a layer of green material in the pools, and white material in the swifter water.

"At 275 yards, where the temperature was 81°, the lower limit of white growths was reached. Below it a dark green moss coated the rocks for a distance of about 50 yards to a point where the temperature was 78°. Below this point there was no notable growth in the channel.

"The material showed a tendency toward brighter colors in the hotter water and more sombre ones in the cooler places. White material (probably due to the deposition of sulphur) was more common in the hottest water and in the lowest portions of the algous growth. Smooth, leathery growths lined the pools, while fibrous growths were formed in the swiftest currents. The discharge of the stream was approximately 100 gallons a minute. The water first rose at a point about 50 yards above the main springs. Above this point the stream channel was dry."

Tassajara Hot Springs is a popular resort, open from May to October and reached by auto stage from Salinas over a 60-mile road, winding for a good part of the distance through the rugged Coast Range. Additional accommodations, including a large annex and tent houses, have been installed as patronage has increased. Mrs. Helen G. Quilty, owner, Tassajara Springs, California.

MOLYBDENUM.

Molybdenite occurs in quartz on the Westcott Ranch, 8 miles east of Soledad. About 5 years ago the *Vancouver Pinnacles Molybdenum Co.* did some work on a prospect here, but nothing of importance was developed.

Bibl: State Mineralogist's Report XVII, p. 156.

NICKEL.

The mineral zaratite, an emerald-green hydrous carbonate of nickel, has been found as a coating on chromite in Monterey County.

Bibl: Blake, W. P., Report, State Board of Agric., 1866.

PETROLEUM.

The possibilities of developing oil in Monterey County in commercial quantities are discussed in Bulletin No. 89, of the State Mining Bureau, 'Petroleum Resources of California,' by Lawrence Vander Leck, 1921. It is further discussed in Bulletin No. 69, 'Petroleum Industry of California,' by R. P. McLaughlin and C. A. Waring, 1914, and much of the geology of the county is mapped in the geological folio accompanying the latter bulletin. Development operations are reported in current issues of the 'Summary of Operations, California Oil Fields,' issued monthly by the Department of Petroleum and Gas of the State Mining Bureau.

No attempt, therefore, was made to include this phase of the mining industry in the present report.

Bibl: State Mineralogist's Report VIII, p. 444; XII, pp. 356, 493; Journal of Geology, Vol. 9, pp. 330–336; Cal. State Min. Bur. Bull. 19, pp. 143–146; 69, pp. 418–438; 89, pp. 31, 32, 82–94; U. S. Geol. Survey Water Supply Paper 89, pp. 13–19; U. S. Geol. Survey Bull. 581-d; 603; 691-h.

QUICKSILVER.

The quicksilver mines in Monterey County from which commercial production has come are associated with an area of serpentine near Parkfield, in the southeastern corner of the county. The output to date has come in the main from one property, the Patriquin Mine.

Dutro Mine. Situated in the SW¼ of SE¼ of Sec. 28, T. 24 S., R. 6 E., M. D. M. Idle for more than ten years past.

Bibl: State Mineralogist's Report XV, p. 613; Bulletin No. 27, p. 124; State Mining Bureau Bull. No. 78, p. 73.

Monte Cristo Group. In the southwestern part of the county near Gorda.

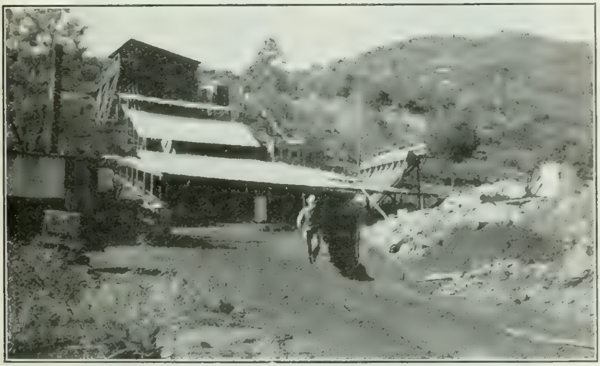
Bibl.: State Mining Bureau Bull. No. 78, p. 73.

Patriquin-Gillett Quicksilver Mining Co. This company produced a few flasks of quicksilver in 1917 from their lease in Sec. 1, T. 23 S., R. 14 E., M. D. M., 5½ miles north of Parkfield. They are no longer operating.

Bibl.: State Mining Bureau Bull. No. 78, p. 73.

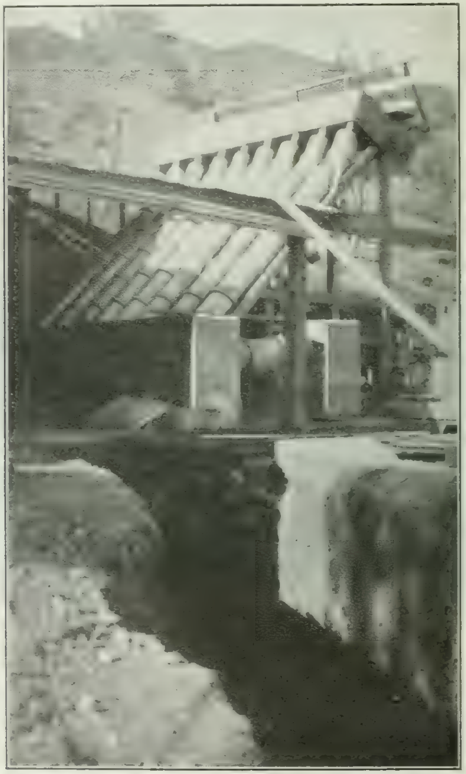
Paloma Mining Co. (Patriquin Quicksilver Mine; also at one time called Pitt; also Cholame-Parkfield; and Parkfield Mine.) This mine has been the principal quicksilver producer in Monterey County. It is situated in Sec. 2, T. 23 S., R. 14 E., 6 miles north of Parkfield. The owners are Louis Patriquin, M. C. Parks, F. A. Anstey, A. J. Piezzi, and O. H. Poehlmann; operating as the Paloma Mining Co.; M. J. Eunson, superintendent.

The present company took over the property on August 16, 1924. Extensive improvements in the reduction equipment and surface plant have been made; a new 60-ton Gould rotary furnace and condensing system being the principal addition. The crushing plant has been reconstructed and an automatic Challenge feeder added.



Rotary Furnace Reduction Plant at Patriquin Mine; Paloma Mining Company (in course of construction), near Parkfield.

Ore from the three tunnel levels is trammed direct to bins above the furnace and dumped on a grizzley, the oversize being broken in a Dodge jaw-crusher. It is drawn from the bins by a Challenge feeder which discharges to a screw feeder 10 feet long, extending through the dust chamber. The screw feeder is driven at 135 r. p. m. The dust chamber is of brick and concrete construction with compression joint between it and the rotary kiln. The rotary furnace is 40 feet in length by 3 feet diameter and is geared to make one complete revolution per minute. It is of the tire-type, resting on roller bearings, and is lined with fire brick. A 15-h.p. Fairbanks-Morse gas engine drives all the machinery except the ore-bin crusher which has a separate drive. Fuel oil is hauled in a tank by truck from Coalinga and delivered to three 200-barrel storage tanks. A Witt oil burner is used and a 40-cu. ft. capacity compressor supplies air at 50-lbs. pressure for the burner. There is a concrete draw pit underneath the discharge end of the furnace of 3-tons capacity for the burned rock. A wooden pipe leads down from the top of the dust chamber to the concrete condensing chambers. In this connecting pipe are 4 water sprays and this is the only point at which water sprays are used. The condenser system comprises a concrete base and wooden top section connected by 8 vitrified pipes set at an angle of about 45°. The fumes pass up the first pipe, down the second, up the third, down the fourth, etc., finally down the last one (in foreground in photo) then back under the set and through a further section of pipe resting at an angle of about 30° to a second concrete chamber and then through approximately 100 feet of pipe resting at an angle of about 30°, to the stack, from which a thin light-colored vapor issues. At the



Condensers at Patriquin Mine, Paloma Mining Company.
Open cut for rotary furnace draw-pit in foreground.

time of visit the plant had been in operation only 5 days and sufficient time had not elapsed to gather reliable data in regard to details of operation, as adjustments incident to a new plant were still being made. It is operated three 8-hour shifts, one man per shift being in charge of the furnace. The plant and camp is electric lighted, a 40-light, 120-volt generator supplying current for all needs. Sixteen to eighteen men are employed underground and on top. All three levels of the mine are being worked, but most of the ore is coming from No. 1 and No. 2 levels. The fire-box of the old Johnson-McKay pipe retort furnace is being rebuilt to permit the use of oil fuel. It will be used for retorting soot and in cleaning up.

Bibl: State Mineralogist's Report XV, p. 613; Cal. State Mining Bureau Bull. 78, pp. 73–75; Bull. 27, p. 123; U. S. Geol. Survey Min. Res. 1915, Part I, p. 269.

Harvesting salt at plant of Monterey Bay Salt Company at Moss Landing, Monterey County, California. Photo by Walter W. Bradley.

ROCK AND GRAVEL INDUSTRY.

No rock-crushing plants are operating in the county, so far as could be learned, sand alone being produced at the present time. Gravel strata, in benches of the Salinas River on the east side, 3 miles north of King City on the road to Metz, have been utilized to some extent in the past. They are interbedded with sand and clay.

Hatton Ranch Deposit. (See Meadows Gulch Deposit, under Structural Stone.)

SALT.

Monterey Bay Salt Company. Vierra Bros., owners, Moss Landing, California. This property is located at sea level at Moss Landing. The Pajaro Valley Railroad (narrow gauge) connects it with Watsonville. It is also on a steamer landing, as indicated by the name.

Salt is extracted from sea water at this plant by solar evaporation. The salt works comprises four ponds. Two months are required for the water to evaporate to the density at which the salt crystallizes out and settles on the bottom of the ponds. The layer of crystals is from 4 inches to 6 inches in thickness.

After the salt has formed, the ponds are drained and the salt is then broken up with shovels and pumped, with saturated brine as a carrier, to a washing plant. Here it is washed, then crushed and screened, and put on the market without further refining.

The product is sold mostly to fish-curing plants at Monterey and to ice cream plants, dairies, and cattle men. Nine or more men are employed in season.

The salt from the waters of the Pacific at this point shows a high analysis, and is said to be more uniform than that from San Francisco Bay water on account of the river waters flowing into the latter. It contains very little magnesia. An analysis of a moisture-free sample shows:

	Per cent
Sodium chloride ($NaCl$)	99.75
Magnesium chloride ($MgCl_2$)	0.00
Sodium sulphate (Na_2So_4)	0.05
Calcium sulphate ($CaSo_4$)	0.14
Water insoluble matter	0.06
Organic matter	nil
Total	100.00

Bibl: State Mineralogist's Reports XV, p. 614; XVII, p. 157.

SAND.

Carmel Development Co. A sand deposit in the form of a large dune near Carmel, formerly owned by this company and utilized to some extent for the production of sand, has been sold to the City of Carmel for playground use.

Del Monte Properties Co. C. S. Olmstead, manager, Pacific Grove; A. J. Gunnell, sales manager, Crocker Building, San Francisco. This company is producing sand on a large scale from two deposits lying between Pacific Grove and Carmel. The principal operations are at the Lake Magella plant three miles west of Pacific Grove near Asilomar. The deposit here consists of large wind-blown dunes extending along the coast for several miles. Extensive alterations have been made in the treatment plant since which time only a small percentage of the output has been sold as 'pit run' sand, practically all of the product, both from the Lake Magella dunes and the Fan Shell beach workings, 4 miles farther down the coast, now being put through the plant and prepared for the various market demands. At the Lake Magella deposit the sand is brought direct to the plant by an electrically-operated drag-line scraper of the V-type. At the Fan Shell beach working the sand is raised into 150-ton bins by a gasoline-operated drag-line scraper, and is then transported by a fleet of five 5-ton trucks to the Lake Magella plant.

At the plant the sand from both workings is passed over special Overstrom concentrating tables of approximately twice the standard length, using fresh wash water from the company's distributing system. The tables remove the garnet, iron, dirt, and most of the mica. From the tables it is pumped by centrifugal sand pumps to a drainage room.

From the drainage room it is taken by conveyor to the steam dryer, housed in a brick building. Here it is dried by indirect heat, by falling through a series of hot steam pipes supplied with live steam from an 80-h.p. oil-fired boiler. The dried sand is elevated and passed through specially designed air separators which remove the last traces of mica. It then goes to storage bins for sacking or loading direct into railroad cars. The plant is electrically operated throughout, about 175-h.p. being required. Eight to ten men are employed in its operation. The present capacity is 25 tons an hour of finished product, but this can be increased. The products are glass sand; building sand, including concrete, mortar and stucco sand; sand-blasting and foundry sand, filter sand, fine sand used in the manufacture of roofing paper, and sand for other miscellaneous uses. It is probable that the mica recovered will have a commercial value as a by-product, and the garnet also, if in sufficient quantity. Installation of the equipment outlined has only recently been completed, and the amount of such by-products that will be produced is uncertain.

Bibl: State Mineralogist's Report XVII, p. 157.

Lapis Sand Plant. Owner, Bay Development Co., Frederick Maurer, president; E. H. Rix, secretary and general manager; Charles Hall, superintendent, Lapis plant. Home office, foot of 4th Street, at Pier 54, San Francisco.

The Bay Development Co. owns 435 acres, comprising Lot 1, Rincon district, City Lands of Monterey, at Lapis, Monterey County. The property is on the west side of the Southern Pacific Railroad and state highway from Watsonville Junction to Monterey, a short distance south of the point where these roads cross the Salinas River. There is a spur track from Lapis to the company's plant. The property is practically all composed of sand dunes parallel to the coast of Monterey Bay, and varies in elevation from sea-level to about 100 feet above. There is no timber or overburden. Water is obtained from wells. The deposit was first opened up in 1906, but the present company did not begin operations until 1918. Sand is being produced at two workings. No. 2 sand is obtained from the dunes and No. 4 sand from the beach working. Excavation is by drag-line scrapers, one being operated by a stationary hoist, and the other by a locomotive run back and forth on the railroad track. The latter is said to be both fast and efficient. The sand is loaded direct to cars without the use of any bunkers, screens or other machinery. Steam power is used, with oil for fuel, about 100-h.p. being required to run the plant. An average of 8 men are employed, and 160 cars per month are produced. The output is consumed in building and construction work for concrete and mortar, also for sand blasting, marble cutting, and as locomotive sand. The sand is hard and sharp, and is particularly well suited for sand blasting and cutting, but it contains too much iron to be used for glass making.

Bibl: State Mineralogist's Report XV, p. 614.

Otey Deposit. (See Meadows Gulch Deposit, under Structural Stone).

Prattco Sand Pit No. 4. This sand deposit is situated 1½ miles north of Seaside on the Southern Pacific Railroad, and contains a total area

Lapis Sand Plant. Beach hoist getting out No. 4 sand.

of 30 acres. Owner, Pratt Building Material Co., 518 Hearst Bldg., San Francisco. C. F. Pratt, president; Howard Center, secretary; L. H. Wolmack, plant superintendent. Local postoffice, Seaside, California. The holdings include both beach and dune deposits which vary in elevation from sea-level to 100′ in altitude. There is no timber or other overburden. The deposit was opened up in May, 1921. The beach sand is elevated by a drag-line scraper, dumping direct to R. R. cars. The dune sand is taken up by a conveyor-loader, which also discharges direct to cars. The plant siding will hold 12 cars. The sand is neither washed nor screened, but three grades are produced: No. 2 (fine) for mortar, No. 4 (coarse) beach sand, and a mixture of No. 2 and No. 4, which is used for concrete work. The entire output is used for building and construction work and sand-blasting. Electric power is used, 120-h.p. being required. Six men are employed and the output averages about 100 cars monthly.

SILVER.

Veins containing galena, thought to be argentiferous, were early reported in a white granitic rock on the Alisal Ranch (see Introduction). A tunnel was run in 125 feet, at which point a winze was sunk about 50 feet and it was in this winze that the ore was found. As near as can be learned, this tunnel and winze were dug more than 100 years ago by three Chileans, under the supervision of the Spanish padres. According to tradition, they erected a small furnace for smelting near the property, but after getting out considerable ore two of them went to the New Almaden mines to get an assay made and never returned.

Bibl: State Mineralogist's Report XV, p. 615. Cal. Sen. Doc. No. 9, 1854, by J. B. Trask, p. 18.

STRUCTURAL STONE.

Deposits of sandstone and other rocks suitable for building purposes have been only superficially developed. A belt of sandstone runs along the east slope of the Santa Lucia Range from T. 21 S., R. 7 E., in a northwesterly direction past Tassajara Springs to T. 19 S., R. 3 E. It was quarried near the springs and used in the construction of the hotel.

Bibl: State Mineralogist's Report XIII, p. 636; Bull. No. 38, p. 131.

Meadows Gulch Deposit. A deposit of light-colored, fine-grained siliceous shale rock, which is easily split into slabs from 1 inch to 3 or 4 inches or more in thickness, is being mined by Albert Otey, Box 263, Carmel, California. The material, locally called chalk rock, occurs in ledges, 3 to 4 feet wide on both sides of Meadows Gulch, which opens into Carmel Valley, on the James Meadows tract, about 10 miles southeast of Carmel. The stone is soft when mined and easily shaped and split, but hardens on exposure. Surface dirt is removed and the stone quarried by hand and sledded down the mountain to trucks which haul it to Monterey for rail shipment, or direct to destination. It is used mainly as a veneering for residences, in fireplaces and as flagstones. Production began in 1921. It has been used in San Jose, Palo Alto, and Berkeley, as well as locally.

Mr. Otey also produces sand from property which he owns at the mouth of Carmel River. The sand is shoveled direct to trucks which are backed down a prepared road. The river sand is said to be better suited for plastering than sand taken from salt water beach deposits.

A deposit of decomposed, coarse granitic rock on the Hatton Ranch, about 1 mile up Carmel Valley from Carmel, is also being quarried by Mr. Otey, for use on walks, roads and driveways in the vicinity of Carmel.

TILE.

Monterey Mission Tile Co. Henry L. Watson, president; T. H. Bane, secretary; home office, Monterey, California. This company started the manufacture of hand-made roof and floor tile at their plant on Mesa road, ¼ mile from the railroad station at Monterey, in July, 1924. Local clays, obtained from various points within a radius of 10 miles of Monterey, are used at present. The clay is worked up to a smooth, plastic mass on a platform by shoveling and treading with the bare feet. The tiles are hand molded, stacked for air drying and then burned in an open top up-draft oil-fired kiln. The daily capacity of the plant is 200 square feet of tile. The average number of men employed is six. The installation in the near future of mixing machinery and other mechanical equipment is contemplated.

LOS ANGELES FIELD DIVISION

W. BURLING TUCKER, Mining Engineer.

ORANGE COUNTY.

GENERAL DESCRIPTION.

Orange County is bounded on the east by Riverside County, north by San Bernardino and Los Angeles counties, west by Los Angeles County and the Pacific Ocean, and on the south by San Diego County. It comprises 795 square miles, about three-fifths of this area being valley land and the remaining two-fifths mountainous and foothill land.

The Santa Ana Range of mountains is the line between Orange and San Bernardino counties, at the northeast corner of the former county. It is also the dividing line between Orange and San Diego and Riverside counties. This range also sends up a line of foothills westwardly along the seashore nearly half way across the county. All the western portion of the county is included in the Santa Ana Valley. The highest point of land has an elevation of 5675 feet above the sea level, and is known as Santa Ana Peak.

PRINCIPAL STREAMS.

The Santa Ana River comes into the county near the northeast corner and continues through it in a southwesterly direction, flowing into Newport Bay. Santiago Creek has its rise in the Santa Ana Range of mountains, and flows in a northerly and westerly direction, emptying into the Santa Ana River about two miles northwest of the city of Santa Ana. Aliso Creek has its rise in the same range, but on the southern slope of the mountains, and runs in a southwesterly direction, flowing into the ocean near Arch Beach, about twenty miles southeast of the mouth of the Santa Ana River. Trabuco, Mission Viejo, and San Juan Creeks have their rise on the south side of the Santa Ana Range and come together near the sea, reaching the ocean at 'San Juan-by-the-Sea.' Coyote Creek marks the boundary of the county on the west.

GENERAL GEOLOGY.

The formation of the region consists of a base of granitic and metamorphic rocks overlain by Cretaceous, Tertiary, and Pleistocene sediments.

The main portion of the Santa Ana mountains is composed of ancient crystalline rocks, mostly slates of Jurassic age; along the western and southern flanks, rocks of Chico age are exposed, which in turn are overlain by small patches of the Eocene. In the Laguna hills the formations exposed are mainly coarse sandstone of Eocene age. These are overlain along the edges of the hills by beds of standstone and shale of the Monterey series. In the flat area running from Tustin to El Toro the diatomaceous shale of the Monterey series is present, occupying a synclinal trough between the Santa Ana mountains and the Laguna hills. This condition continues southeast through the Capistrano district to the San Diego County line.

For detailed Geology of Orange County the reader is referred to the reports by Bowers[1] and Fairbanks[2] in two of the earlier State Mineralogist Reports.

MINERAL RESOURCES.

Orange County stood third on the list of mineral producing counties of California for the year 1923, due mainly to its petroleum production. Other items yielded in commercial quantities are: Clay products, natural gas, gold, lead, silver, and miscellaneous stone.

Aside from the substances actually produced, Orange County is well supplied with such valuable minerals as coal, gypsum, iron, infusorial earth, sandstone and tourmaline.

METALS.

GOLD.

Gold has been found at a number of points in the Santa Ana Range. The gold placer deposits of Lucas Canyon, a tributary to San Juan Canyon, located northeast of San Juan Capistrano, have been worked in a small way since the early days of the Spanish priests. At present writing Joaquin and Tomas Serano of El Toro are operating in the Canyon. Auriferous quartz veins have been discovered in Ladd and Trabuco Canyons, and a number of properties developed to some extent, although there has been no commercial production to date. The principal gold production in the county was made from 1889 to 1900.

MINES.

Santa Ana Mines comprise a group of 34 claims located in Trabuco Canyon, 14 miles east of El Toro. Elevation 2500 feet. Owners, *Santa Ana Mining Company;* Gail Borden, president; L. C. Comer, secretary. Offices, 506 Byrne Bldg., Los Angeles.

This property was originally located as a tin mine, but no ores containing tin were discovered. The formation is black carbonized slate. It is stated that the quartz stringers cutting the slate carry values in gold.

Development: Consists of two crosscut tunnels; one located on the north side of the canyon is 300 feet, and about a quarter of a mile down the canyon on the south side is another tunnel 150 feet in length.

Equipment: One 9″ x 15″ Blake crusher, ten stamps, two Challenge ore feeders, 12-compartment settling tank, and four 4′ x 8′ agitators. Idle.

Williams Mine. The mine is locateed in Ladd Canyon in T. 5 S., R. 7 W., 18 miles east of Orange. Owner, J. Goodby of Los Angeles.

The country rock is porphyry and slate. The vein strikes north and south and is from 12 inches to 2 feet in width. A crosscut tunnel was driven west 100 feet to intersect the vein. Workings caved. Idle.

---

[1] Bowers, Stephen, Orange County: State Mineralogist Report X, pp. 399-409, 1890.

[2] Fairbanks, H. W., Geology of San Diego County; also portions of Orange and San Bernardino counties: State Mineralogist Report XI, pp. 113-118, 1893.

ORANGE COUNTY—TABLE OF

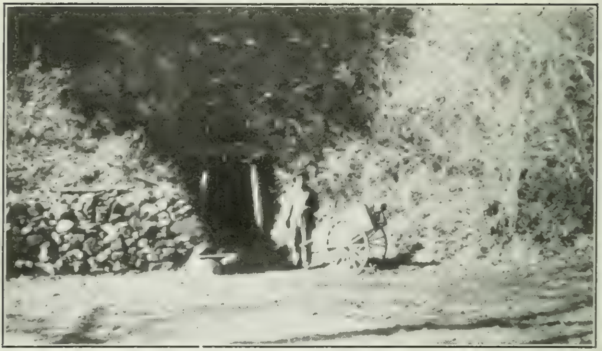
Year	Petroleum		Natural gas	Brick	
	Barrels	Value	Value	M.	Value
1889	----------	----------	----------	----------	----------
1890	----------	----------	----------	----------	----------
1892	----------	----------	----------	----------	----------
1894	----------	----------	----------	----------	----------
1895	----------	----------	----------	----------	----------
1897	12,000	$12,000	----------	----------	----------
1898	60,000	60,000	----------	300	$2,400
1899	108,077	108,077	----------	200	1,600
1900	254,397	254,397	----------	----------	----------
1901	302,652	181,591	----------	----------	----------
1902	1,103,793	824,492	----------	----------	----------
1903	1,355,104	1,016,285	----------	1,634	13,000
1904	1,470,000	1,144,542	----------	1,500	9,000
1905	1,510,900	711,633	----------	118	11,800
1906	2,388,000	1,194,000	----------	1,365	13,500
1907	2,426,750	1,456,050	----------	3,176	26,000
1908	3,376,689	2,532,517	----------	4,050	20,450
1909	4,270,967	2,690,709	----------	4,090	20,650
1910	5,044,001	3,177,721	----------	2,950	31,000
1911	6,345,275	4,097,980	----------	1,650	11,550
1912	6,704,421	4,478,553	$5,250	1,300	9,100
1913	9,485,362	6,867,402	9,612	2,100	14,000
1914	12,758,678	8,612,108	112,040	1,333	19,300
1915	12,715,457	6,510,314	81,753	1,280	16,000
1916	13,198,591	8,750,666	139,281	1,186	8,300
1917	14,680,801	14,724,843	490,511	and tile	11,000
1918	15,730,462	22,211,412	693,169	477	3,869
1919	14,458,722	26,893,223	837,439	[2]	----------
1920	15,462,741	33,059,340	862,446	[2]	----------
1921	22,929,466	45,996,509	1,312,704	2,994	47,720
1922	31,049,491	36,483,162	2,096,629	4,706	73,106
1923	46,474,921	40,897,930	3,914,661	8,499	103,428
Totals	245,677,718	$274 947,456	$10,555,495	44,908	$466,773

[1] Includes crushed rock, rubble, rip-rap sand, gravel.

[2] See under 'Unapportioned.'

MINERAL PRODUCTION, 1889-1923.

Clay		Stone industry[1] value	Miscellaneous Minerals		
Tons	Value		Amount	Value	Kind
...	...	...	...	$6,262	Gold.
...	...	...	...	10,943	Gold.
...	...	...	...	9,470	Gold.
...	...	...	1,500 tons	6,000	Coal.
...	...	...	900 tons	4,000	Coal.
			...	144	Gold.
...	...	...	...	...	
...	...	...	800 tons	3,200	Coal.
...	...	...	600 tons	2,400	Coal.
			25 tons	250	Gypsum.
...	...	...	240 cu. ft.	120	Sandstone.
			...	2,407	Gold.
			500 tons	2,250	Coal.
...	...	...	300 tons	1,500	Coal.
			...	4,000	Gold.
...	...	...	...	250	Gold.
...	...	...	...	150	Gold.
...	...	...	408 cu. ft.	200	Sandstone.
10,500	$14,581	...	500 cu. ft.	250	Sandstone.
7,740	12,900	...	...	...	
			964 lbs.	193	Copper.
...	...	...	24,472 lbs.	1,303	Lead.
			33,546 lbs.	2,000	Zinc.
9,000	18,600	$3,005	14,405 lbs.	534	Lead.
2,617	26,170	23,665	...	72,586	Unapportioned, 1900-1909.
500	5,000	6,443	...	...	
2,000	3,200	855	...	...	
2,100	3,400	21,248	459 tons	688	Glass sand.
15,500	20,666	36,815	...	...	
...	...	88,315	...	...	
...	...	9,027	364 lbs.	17	Lead.
			4 lbs.	1	Copper.
...	...	3,773	...	3,066	Other minerals.
[2]	...	2,699	...	2,573	Pottery clay, copper, lead.
3,649	4,650	1,560	...	...	
[2]	...	1,944	...	18,499	Clay and clay products.
			...	97,632	Lead and potash.
			455 lbs.	84	Copper.
			...	145	Gold.
[2]	...	80,988	15,932 lbs.	1,275	Lead.
			...	7,263	Silver.
			...	96,595	Brick, clay, potash.
...	...	131,301	...	10,796	Pottery clay, copper, gold, lead and silver.
...	...	270,022	...	3,168	Clay (pottery), gold, lead and silver.
...	...	536,767	...	16,203	Clay (pottery), copper, gold, lead and silver.
[2]53,606	$127,656	$1,218,427	...	$369,918	



Portal of main tunnel, Yaeger Mines, Trabuco Canyon, Orange County.

Yaeger Mines (Quartz). Comprise a group of 15 claims located in Secs. 2, and 3, T. 6 S., R. 6 W., at the head of Trabuco Canyon, on the southwest slope of the Santa Ana Range of mountains, 17 miles east of El Toro. Owner, Jacob Yaeger, Fullerton. Elevation 3000 feet.

The country rock is granite, quartzite, and slate. The veins occur in granite and slate along fault zones. Four parallel veins which have a strike of N. 30° W., and a dip of 60° N.E. have been developed. These appear to be mineralized zones following faults. In width the veins vary from 12 inches to 10 feet. The ore developed carries gold, silver, lead, and zinc, some copper, and considerable pyrite.

Development: Consists of over 3000 feet of tunnels. The main working tunnel starts on the Julian Claim and is driven 1800 feet S. 60° W., intersecting three veins. It is stated that samples cut in the neighborhood of these three veins assayed from $7.00 to $20.00 per ton in gold and silver. Six other tunnels driven on the different claims have lengths varying from 65 to 550 feet.

Equipment: Blacksmith shop, assay office, and old mill consisting of No. 3 Dodge crusher, rolls and Frue vanner. Two men employed.

QUICKSILVER.

The occurrence of cinnabar is mentioned in Report XI of the State Mineralogist, page 118, as being found in an outlying hill of Tertiary sandstone known as Red Hill, 2 miles east of Tustin. The sandstone dips north at a small angle and consists of a loose aggregate of quartz grains cemented by a kaolinitic material. On the north side of the hill are a number of veins of heavy spar (barite) striking east and dipping south. These veins are not over a few inches wide and carry in a few places the steel-colored mercury which on its surface presents a reddish tinge. Several tunnels were driven into the hill, but failed to develop any ore.

LEAD, SILVER, and ZINC.

Ores containing lead, silver, and zinc occur on the west slope of the Santa Ana mountains. The mineral belt is two miles wide, and extends from the Morrow Group of mines, located in Santiago Canyon, north to the Blue Light mine in Silverado Canyon, a distance of eight miles.

The most important mines that have been developed to any extent are the Old Dominion, Morrow, and Blue Light. The country is formed, to a great extent, of dikes of greenish to blackish rocks, often showing distinct hornblende crystals. The mines south of Silverado Canyon are in a feldspathic rock which is probably an intrusive porphyry. The crystalline rocks of this region are of Cretaceous age.

Blue Light Mine. This property, formerly known as the Silverado Mine, is located in Silverado Canyon, 20 miles east of Orange, in Secs. 11 and 14, T. 5 S., R. 7 W.; elevation 2650 to 2950 feet. Owner, *Blue Light Silver Mines Company;* Charles Egabroad, president; C. S. Chapman, vice-president and managing director; S. L. Collins, secretary; O. H. Pembert, superintendent. Offices, F. & M. Building, Fullerton. Holdings comprise 13 claims consisting of 269 acres, 60 acres of which is patented.

Two parallel lodes known as Blue Light lode and Dike vein occur in the metamorphic rocks. The former having proved the most productive, has been extensively developed along its outcrop for a considerable distance. The veins have widths of 2 to 6 feet. The ore is silver-bearing galena, associated with zincblende and pyrite. Irregular lenses of complex lead-zinc sulphide ore occur in these two lodes. Seven known ore bodies have been developed on the Blue Light lode, in the north and south workings from No. 3 tunnel on the Blue Light claim. The Blue Light vein strikes N. 16° E., dips 30° to the east, and has been proved on the surface for a distance of 4500 feet. The average width of the vein is 4 feet. The vein has been developed by seven tunnels. At an elevation of 3000 feet No. 2 tunnel is driven on the vein 350 feet. No. 3 tunnel, which is 50 feet below No. 2 tunnel, is a crosscut for 200 feet to the vein, and then a drift for 470 feet south on the vein. This tunnel is connected by raises and stopes with No. 2 tunnel workings.

The most recent development has been in driving No. 7 tunnel, which is located north of No. 3 tunnel workings, and at a vertical elevation of about 400 feet below No. 3 workings in Pine Canyon. The tunnel is driven 50 feet southwest, then as a crosscut 110 feet east to the vein, with a drift south 800 feet on the vein, with the expectation of developing the known ore shoots worked in the upper levels. It is reported that 8000 tons of ore have been developed above No. 3 tunnel level, and that this ore has an average value of 0.06 oz. gold, 25 oz. silver, 4% lead, and 13% zinc.

Equipment: One 14″x8″x8″ Clayton compressor driven by semi-Deisel Y-type Fairbanks-Morse gas engine, air drills, blacksmith shop, assay office, cars, and track.

Mill: A 50-ton flotation plant, two 9″x15″ Blake-type jaw crushers, driven by 30-h.p. West Coast gas engine, Challenge ore feeder, 5′x4′ ball mill in closed circuit with Dorr classifier, one 12′ K & K flotation machine, two 6′ K & K flotation machines, 1 Wilfley, 1 Overstrom, and 1 Cottrell table, two Dorr thickeners, and 1 Denver filter. The flotation plant is driven by 100-h.p. Fairbanks-Morse semi-Deisel gas engine.

In 1907 the mine produced 38,877 pounds of lead and 33,546 pounds of zinc; in 1920 it produced 15,932 pounds of lead; and in 1922 it produced 81,400 pounds of lead concentrates.

Due to the complex character of the ore, the treatment of the ore by flotation methods has not proved successful as the lead and zinc sulphides are very finely associated. The lead concentrates produced carried as high as 14 to 30% zinc.

Ernst Harms and John Ellingham of Anaheim have installed a small plant at Anaheim and have contracted with the company to treat its ores by the hydrometallurgical process. Tests are being conducted at present and if the process proves successful in the treatment of the complex lead-zinc ores of the mine, this property may become an important producer. The company plans to continue development work on No. 7 tunnel level. Ten men are employed.

Bibl: State Mineralogist Report XX, pp. 43-45.

Morrow Group of Mines (Lead-Silver). This property is located in Santiago Canyon, in T. 5 S., R. 6 W., 9 miles northeast of El Toro, and comprises five claims: Alma, Geneva, Modjeska, King Solomon, and King Tut. Elevation 2600 feet. Owner, W. S. Morrow of Orange. The country rock is diorite, quartzite, and slate.

The veins strike approximately north and dip about 35° to the east. The mineralized zone has a width of 10 feet, but the pay ore occurs as stringers and irregular lenses varying in width from 12 inches to 3 feet.

The ore is galena, zincblende, pyrite, and a little antimony. The sorted ore shipped is stated to carry 40 ozs. silver, 24% lead, and 10% zinc.

This property has been worked at intervals for thirty years. In 1896–1897 the property was operated by the Santiago Mining Company, but since that date it has been operated at intervals by different lessees.

Developments: On the Alma claim there are three tunnels, the main tunnel being 600 feet, and two crosscut tunnels 100 to 175 feet in length. There are a number of tunnels on the other claims.

The ore was packed out over a trail 4 miles, then hauled to the railroad at El Toro. It is stated that the property has produced considerable lead ore carrying high values in silver. Idle.

Old Dominion Mine. (Lead-Silver, Zinc.) The mine is located at the head of Long Canyon, a tributary to San Juan Canyon in T. 6 S., R. 5 W., 6 miles west of Elsinore. Elevation 3400 feet. Owners, M. L. Cambern and A. Schneider of Elsinore.

NONMETALS.

CLAY.

On the west side of the Santa Ana range are deposits of clay which will probably be found to equal in geologic age and commercial properties the clays of Temescal Valley, Riverside County. The clay beds are quite variable in character, at different points containing white and red plastic clay, and gray and black flint fire clay.

Fire clay is reported in Hicks Canyon in the SE¼ of Sec. 2, T. 6 S., R. 7 W., S. B. M. Also in Bell Canyon in the NE part of Sec. 24, T. 6 S., R. 7 W. On the ranch of Louis Moulton, south of El Toro, on Aliso Creek, there is a deposit of good bluish clay.

The low-grade clays used in the manufacture of red brick and red tile are fairly abundant in the county. On the ridge west of the Santa Ana River, south of Wintersburg, is found a deposit of good clay. The clay in the ridge has been opened up on Sec. 35, T. 5 S., R. 11 W., S. B. M., on both sides of the branch line of the Southern Pacific Railroad from Newport to Smeltzer. The clay is very compact, of a dark gray color, in places tinted slightly red by iron oxide.

PLANTS.

Garber Brick & Tile Company; H. Garber, president. The company control six acres, one-half mile east of Olive. The plant manufactures common brick, hand-made roofing tile, and floor tile, also roof dressing material, and a dust product for molding sand. Material is transported from clay pit by drag-line scraper to plant, where it passes through rolls, is then elevated to storage bins, then to the clay mixer and to the brick press. The bricks are then conveyed over a cable conveyor to drying racks, and are then burned in field kilns. Roofing and floor tile are made by hand. Oil and natural gas are used as fuel.

Equipment: Consists of a 30-h.p. boiler, Ingersoll-Rand compressor, Blake type of crusher, screens, elevators for crushing rejects for roof dressing and molding sand. Ten to twenty men are employed.

Plant of the La Bolsa Tile Company, Weibling, Orange County.

La Bolsa Tile Company; George W. Moore, president; A. W. Griffith, secretary; E. R. Bradbury, superintendent. Offices, Huntington Beach. The plant is located two miles north of Huntington Beach at Wiebling Siding on the Southern Pacific Railroad. The company owns 31 acres located in Sec. 35, T. 5 S., R. 11 W., S. B. M. They manfacture drain tile from 3 to 20 inches in diameter, hollow building blocks, and common brick.

The capacity of its plant is about 25,000 linear feet of tile per month, and is equipped with 90-h.p. gas engine and a 70-h.p. boiler. Ten men are employed.

The clay from the pit is hauled by Fordson tractor to a hopper, from which it passes to the dry pan crusher; it is then conveyed by a vertical elevator into the hopper, which discharges the ground material into a short pugmill from which it passes into a lower pugmill provided with an auger which forces the clay through the die upon the wire cutting table. The tiles up to 8 inches in diameter are cut to the length of 13 inches, those of larger diameter to that of 27¼ inches. There is also one steam press machine for tile of 10, 12, 18, and 20-inch diameter. The drying sheds are heated by hot air forced by blower through flues under the floor. This hot air is obtained either from exhaust of the kilns or by forcing air through a coil stove heated by exhaust steam from the boiler. The drying sheds have a storage capacity of 60,000 tile. The smaller-sized tile are dried in 24 hours or more; the larger tile require 60 hours. The plant is equipped with three 28-foot and one 32-foot down-draft kilns, using oil and natural gas as fuel, having one main flue and one stack.

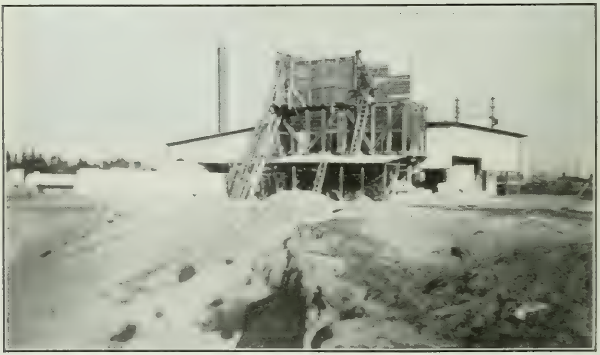
Los Angeles Pressed Brick Company owns and operates an important deposit of fire clay of high quality lying a few miles south of the Santa Ana River.

The clay is a black flint fire clay which shows a thickness of about 20 feet, and is overlain by about 10 feet of blue clay and some reddish-colored plastic clay.

The material is hauled to Gypsum Station on the Santa Fe Railroad, and shipped to the company plant located in Los Angeles.

Orange County Brick and Tile Company: F. C. Krause, president; Charles Page, secretary; W. J. Carmichael, general manager. The company owns nine acres in Sec. 9, T. 4 S., R. 10 W., within the city limits of Anaheim.

The company is manufacturing building brick, and also produces sand for building purposes. The material used is unconsolidated sand. The sand is mixed with lime and cement in the following proportions:



Plant of the Orange County Brick and Tile Company, Anaheim, Orange County.

Common brick: lime 7½%, cement 2%. Face Brick: lime 10%, cement 5%.

Material from the sand pit is transported by drag-line scraper to a hopper, from which it goes to a bucket elevator, elevated and then passed through a revolving screen. Here it is sized into three different sizes: the over-size and the minus 8-mesh going to storage bins, the fine sand to wet grinding pan, where it is ground and then elevated to two bins, then sent on to the mixer from which it is fed to two American clay brick rotary presses. One press has a capacity of 8000 brick, the other 17,000 brick. The brick then are loaded onto cars and given 10-hour heat treatment under 125 pounds pressure in two Hardinge cylinder dryers. These dryers are 80 feet long by 6 feet in diameter. Heat for cylinder dryers is furnished by 70-h.p. boiler, oil being used as fuel. The other equipment is driven by electric motors. Ten men are employed.

COAL.

During the period extending from 1888 to 1892 there was considerable activity in the development of the coal deposits of Orange County and some production made which was used locally. There were three coal mines located in a series of clay shales and sandstone of Cretaceous age. These are on the east side of Santiago Creek. This belt containing seams of coal extends northeast from Silverado Canyon for a distance of about five miles. The properties are briefly mentioned by Bowers[1] and by Fairbanks.[2] These properties were known as the *Black Star*, *Santiago* or *Santa Clara*, and *Harris Mines*.

The latest development on the coal deposits was during 1914 and 1915 by the *Orange County Coal Mining Company* of Santa Ana, on the *Santiago Coal Mine*.

The Santiago Coal Mine is located 9 miles east of Orange in T. 4 S., R. 8 W., S.B.M., east of Santiago Creek. Elevation 1100 feet. Holdings comprise 100 acres of patented ground owned by Mrs. S. M. Craddick of Orange. The above mentioned company sunk an incline shaft on a seam of coal to a depth of 255 feet. At a depth of 189 feet a drift was run east along a fault for a distance of 200 feet. The seam of coal developed varied in width from 10 inches to 3 feet. The production was small, being used locally for domestic and other purposes. The Orange County Coal Company suspended operations in 1915, and no further development has been attempted since that date.

GYPSUM.

Gypsum Canyon Deposit. A deposit of gypsum occurs in Gypsum Canyon, on the west slope of the Santa Ana mountains, five miles south of Corona. It is in the form of a bunchy vein in rocks of probably Upper Cretaceous age. The strata are chiefly sandstone. The deposit has a thickness of 8 to 10 feet. The gypsum is white and crystalline and is almost as clear as alabaster. At one spot a mass of dolomite was found inclosed in it. The deposit is so situated as to be in easy reach of the valley lands where it has been used to some extent for land fertilizer. It has been found that gypsum has great value in neutralizing the alkalies present in large quantities in some of the valley lands of the State.

Bibl.: U. S. Geol. Survey Bulletin 223, pp. 120-121.

---

[1] Bowers, Stephen, State Mineralogist Report X, p. 403, 1890.

[2] Fairbanks, H. W., State Mineralogist Report XI, pp. 113-114, 1893.

LIMESTONE.

Capistrano. A deposit of fossiliferous limestone is located in Sec. 31, T. 7 S., R. 7 W., S.B.M., one mile north of San Juan Capistrano. R. Egan of San Juan Capistrano, owner.

The limestone was formerly burned for lime by the padres for the building of the San Juan Capistrano Mission.

Ladd Canyon. A deposit of grayish-black crystalline limestone is located along the slopes of the West Fork of Ladd Canyon, 20 miles east of Santa Ana. Elevation 2200-2900 feet. Ten claims have been located in Secs. 3, 4, and 33, T. 4 S., R. 7 W., S.B.M., by Leo Kroonen of Corona. The deposit where it is exposed by the canyon is about 400 feet thick. Analysis of the limestone made by Frederick W. Huber of the University of California is as follows:

	Per cent
Silica (SiO_2)	1.34
Lime (CaO)	51.45
Iron and alumina (Fe_2O_3 & Al_2O_3)	1.95
Magnesia (MgO)	1.86
Ignition loss (H_2O)	43.08
Undetermined	0.32
Total	100.00

The limestone is reported to be suitable for the manufacture of cement.

El Toro. Extensive beds of fossiliferous limestone are found on the William L. Moulton Ranch, 3½ miles south of El Toro. The deposit has been under lease to the *Marine Shell Fertilizer Company.*

A crushing plant was installed in 1922, and operated during 1923, and the crushed limestone sold locally for soil fertilizer. The material from opencut was transported in cars and dumped into an incline chute, passing through a No. 4 Wheeling jaw crusher, which was driven by 25-h.p. Fairbanks-Morse gas engine. The crushed material from No. 4 crusher is conveyed over a belt conveyor to a No. 2 Wheeling crusher. The material from this crusher passes onto a 24-inch belt conveyor to a shaking screen, where it is screened to 8 mesh, oversize from screen going to Williams rolls. The minus 8-mesh material is elevated by bucket elevator to storage bins. The plant is driven by a 50-h.p. gas engine.

The following analysis of this limestone is reported: Calcium carbonate 96%; silica 2.5%; alumina 1%; iron oxide 0.5%. The plant is idle at present.

PETROLEUM and NATURAL GAS.

Orange County production of petroleum for the year 1923 amounted to 46,474,921 barrels valued at $40,897,930. In addition to this, natural gas was reported as valued at $3,914,661. The principal productive oil fields of the county are: Brea-Olinda, Coyote Hills, Huntington Beach, Newport, and Richfield. For detailed description of the different oil fields of the county see Bulletin No. 69, 'Petroleum Industry of California,' and Bulletin 89, 'Petroleum Resources of California'; also State Oil and Gas Supervisor's Annual Reports.

Bibl: Bulletin 19, pp. 57-61, 79-82, 177-180; Bulletin 32, p. 20; Bulletin 63, p. 334; Bulletin 69, pp. 118, 308, 350, 366, 503;

Bulletin 89, pp. 136-139; State Oil and Gas Supervisor's Annual Reports, Vol. I, pp. 173-176, 180-181; Vol. II, pp. 129-146; Vol. VII, No. 5; Vol. VIII, No. 9; Vol. IX, No. 6.

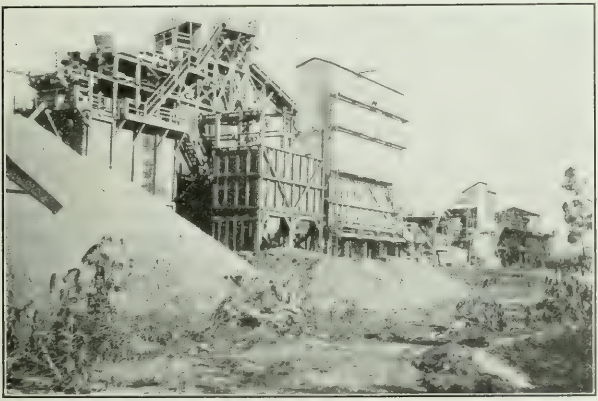
STONE INDUSTRY.

The rapid growth of the cities and towns of Orange County has caused an increased demand for building materials, especially crushed rock, sand, and gravel. A number of gravel plants are under operation on Santiago Creek near Orange; there is also a number of sand plants on the Santa Ana River. The materials are used for the construction of buildings, concrete, and road work.

CRUSHED ROCK, SAND, and GRAVEL PLANTS.

Bixby Pit. A crushing plant operated by Orange County is located one mile east of Olive on the Bixby ranch. The material handled is a decomposed granite and is used on the roads of the county. The capacity of the plant is 350 yards per day.

The material from opencut is transported by drag-line scraper to a hopper, from which it passes through a revolving screen with 1¼-inch perforations. The through-size material is elevated by bucket elevator to storage bins, and the over-size goes to 10-inch x 20-inch Blake type crusher. From the crusher it is fed to a revolving screen with 1-inch perforations, the over-size going to 9-inch x 15-inch Blake type crusher, through-size going to receiving bins. The plant is driven by motors, two crushers being driven by two 20-horsepower gas engines. Six men are employed.



Rock Crushing Plant, Orange County Rock Company, Orange.

Orange County Rock Company, Inc. A. G. Wright president; O. W. Bachman, secretary, Orange. The crushing plant is located on Santiago Creek near North Prospect and McPherson Streets, within the city limits of Orange. The capacity of the plant is 2500 tons daily.

The gravel from Santiago Creek is loaded into a train of three cars having a capacity of four yards each, by a Marion gas-electric shovel.

The cars are hauled by a Plymouth gasoline motor to storage bins where the gravel is dumped over a grizzly, the bars being spaced ten inches apart. All boulders that will not pass the grizzly are stored in the yard. From receiving bins, the 10-inch and finer gravel goes to a No. 5 Blake type jaw crusher, then to 42-inch belt conveyor, which conveys the material to a revolving grizzly, where the rock is screened to 2¼-inch. The oversize goes to a Telsmith crusher, where it is reduced to two inches. This sized material is carried in a bucket elevator to a dry screening plant, and all material over 1½ inches is returned to a Weston crusher, where it is crushed to one-inch size. It is then elevated by a bucket elevator and returned to a dry screening plant, where it is screened by Gilbert revolving screens, producing the following sizes: 1½-inch, 1-inch, ¼-inch, 1/16-inch, and dust, which drop into their respective compartments in the storage bins. The minus 2¼-inch material from the revolving grizzly is conveyed by 22-inch belt conveyor to washing plant, where it is sized by Gilbert system of revolving screens, making the following products: 2-inch, 1½-inch 1-inch, ⅜-inch to 1/16 inch, and sand. The sand goes to two 12-inch log washers. The sand is deposited in bunkers and also in ground storage in the yard. The capacity of storage bunkers for products is 800 yards. Railroad cars and trucks are loaded, according to specifications, by a 22-inch belt conveyor through gates from each bin.

Electric power is used to operate the plant, the total capacity being 386 horsepower.

The company owns and has under lease 286 acres along Santiago Creek. The plant is the largest rock and gravel plant in Orange County. The cost of operation varies from 50 to 75 cents per yard. Twenty men are employed.

Santa Ana Rock and Gravel Company. R. S. King, president; M. M. Ford, secretary. Offices, 211 West First Street, Santa Ana. The plant is located on Santiago Creek, near South Shaffer Street, Orange. The company owns 21 acres along Santiago Creek. The capacity of the plant is 250 yards per day.

The gravel from the creek bed is loaded into Western dump cars by a Northwest Engineering Company gasoline-driven shovel. The cars have a capacity of 1½ yards. Two trains of two cars are hauled by Fordson motors to the plant where the gravel is dumped onto a grizzly, the bars being spaced eight inches apart. From the grizzly the gravel passes to a hopper. It is then elevated by bucket elevator to the washing plant and passed through a revolving screen where it is screened to the following sizes: 2½″, 1″, and ¼″. The over-size from the revolving screen goes to a No. 8 Fort Wayne crusher, the crushed material returning to the screen, the 2″ material to the stock pile, 1″ and ¼″ rock to receiving bin, and sand of from ¼″ to ⅛″ to the bin. A 25-h.p. motor drives the rock breaker and screen; and a 5-h.p. motor drives the belt conveyor. Twelve men are employed.

Yaeger Rock Company. William F. Yaeger, president; Lillian Yaeger, secretary. Offices, 410 N. Spadra Street, Fullerton. The plant is located on Santiago Creek, one mile southeast of Orange. The company owns 23 acres along Santiago Creek. Capacity of the plant is 300 yards per day.

View of shovel in gravel pit, Yaeger Rock Company, Orange.

The gravel is loaded by a Northwest Engineering Company gasoline-driven shovel into two 2-ton cars which are hauled by gasoline motor to the plant. The material is dumped into a receiving hopper from which the gravel is elevated by bucket elevator to a revolving screen, where it is graded to the following products: 2″, 1″, ¼″. The fine material from the trommel goes to an 8-mesh revolving sand screen. The over-size from this screen is returned to a No. 4 Telsmith gyratory crusher. The crushed product from the gyratory is elevated to the washing plant and is then returned to the revolving screen. Four products are produced. The gyratory crusher is driven by a 30-h.p. motor. A 50-h.p. motor drives the trommels and conveyors. Eight men are employed.

W. *Brady*, R. D. 2, Orange, is operating a gravel pit on Santiago Creek.

SAND.

The following operators were producers of sand for building purposes:

Cunningham & Son, Garden Grove, are operating a screening plant on the Santa Ana River, northeast of Garden Grove.

Garden Grove Sand & Gravel Company, 205 E. First Street, Long Beach, are operating a screening plant on the Santa Ana River, two miles northeast of Garden Grove.

La Habra Sand & Gravel Company, 312 E. Santa Fe Street, Fullerton, were producers during the year 1924.

Lindauer & Sons, 200 W. Central Avenue, La Habra, were producers during the year 1924.

R. P. Mitchell of Garden Grove owns a screening plant near the Santa Ana River, three miles northeast of Garden Grove.

Sparks & McClelland, 312 W. Center Street, Anaheim, are operating two screening plants on the Santa Ana River, two miles east of Olive.

J. O. Swartzbaugh, R. D. 2, Box 45, Orange, operates two screening plants located on the Santa Ana River, three miles southeast of Anaheim.

OIL FIELD DEVELOPMENT OPERATIONS.

By R. D. Bush, State Oil and Gas Supervisor.

From October 5, 1924, to and including January 24, 1925, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Premier Oil Co.	24	20	14	28	Coalinga
C. J. Howell	25	14	19	1	Fresno County
KERN COUNTY:					
Bear State Oil Co.	30	28	21	13	Belridge
Belridge Oil Co.	34	30	24	7	Elk Hills
Pacific Oil Co.	35	30	24	5	Elk Hills
Pacific Oil Co.	35	30	24	89	Elk Hills
Pacific Oil Co.	35	30	24	108	Elk Hills
Pacific Oil Co.	35	30	24	110	Elk Hills
Pan American Petroleum Co.	1	31	24	Crampton 3-I	Elk Hills
Pan American Petroleum Co.	6	31	25	Crampton 4-B	Elk Hills
Petroleum Producers, Inc.	14	31	24	1	Elk Hills
Standard Oil Co.	31	30	25	Kern Co. 20	Elk Hills
Standard Oil Co.	36	30	24	Tupman 43	Elk Hills
C. S. Akers	34	27	27	1	Kern River
East Puente Oil Co.	4	29	28	1-A	Kern River
Kern River Oilfields of California	33	28	28	1-AA	Kern River
Marland Oil Co.	16	28	27	Cauley 2	Kern River
Section Five Oil Co.	9	29	28	7-A	Kern River
H. R. Wiseman	26	28	28	Faith 2	Kern River
Universal Consolidated Oil Co.	32	26	21	44	Lost Hills
Berry & Keller	13	30	21	8-A	McKittrick
J. F. McMahon	29	30	22	3	McKittrick
Northern Counties Oil Co.	18	30	22	1	McKittrick
Washington Petroleum Corp.	8	30	22	3	McKittrick
Balboa Oil Co.	24	31	23	44	Midway
Bell Evans Oil Co., Inc.	35	32	23	7	Midway
Berry & Ewing	31	32	24	5	Midway
Big Ten Oil Co.	36	32	23	6	Midway
Brookshire Oil Co.	24	31	22	14	Midway
Brookshire Oil Co.	24	31	22	15	Midway
C. C. M. O. Co.	22	31	22	34	Midway
Federal Drilling Co.	20	31	24	1	Midway
Honolulu Consolidated Oil Co.	6	32	24	25	Midway
Honolulu Consolidated Oil Co.	6	32	24	26	Midway
Honolulu Consolidated Oil Co.	6	32	24	27	Midway
Honolulu Consolidated Oil Co.	6	32	24	36	Midway
Honolulu Consolidated Oil Co.	6	32	24	46	Midway
Honolulu Consolidated Oil Co.	6	32	24	47	Midway
Honolulu Consolidated Oil Co.	6	32	24	64	Midway
Honolulu Consolidated Oil Co.	6	32	24	66	Midway
Honolulu Consolidated Oil Co.	6	32	24	77	Midway
Manley & McGinn	15	31	22	10	Midway
Marland Oil Co.	19	31	23	4	Midway
Midland Oilfields Co., Ltd.	24	31	23	13	Midway
Midland Oilfields Co., Ltd.	24	31	23	14	Midway
Mocal Oil Co.	26	31	22	13	Midway
North American Oil Cons.	30	31	24	14	Midway
North American Oil Cons.	30	31	24	15	Midway
North American Oil Cons.	30	31	24	16	Midway
Pacific Oil Co.	19	31	24	9	Midway
Pacific Oil Co.	35	32	24	11	Midway
Pacific Oil Co.	31	31	24	32	Midway
Pacific Oil Co.	5	32	24	47	Midway
Pacific Oil Co.	19	31	24	49	Midway
Pacific Oil Co.	29	31	24	49	Midway
Pacific Oil Co.	5	32	24	51	Midway
Pacific Oil Co.	25	31	23	65	Midway
Pacific Oil Co.	31	31	24	70	Midway
Pacific Oil Co.	31	31	24	236	Midway
Pyramid Oil Co.	28	32	24	11	Midway
San Jose-Elk Hills Oil Co.	26	31	24	1	Midway
Surprise Oil Co.	36	32	23	10	Midway
General Petroleum Corp.	12	11	24	60-A	Sunset
General Petroleum Corp.	12	11	24	70-A	Sunset
J. W. Jameson	2	11	24	3	Sunset
Midway Northern Oil Co.	32	12	23	11	Sunset
Midway Oil Co.	35	12	24	370	Sunset
Midway Oil Co.	35	12	24	395	Sunset
Obispo Oil Co.	32	12	23	9	Sunset
Pliocene Oil Co.	18	11	23	4	Sunset

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
St. Anthony Oil Co.	10	11	24	1	Sunset
Standard Oil Co.	36	12	24	M. J. M. & M. 56	Sunset
Standard Oil Co.	36	12	24	M. J. M. & M. 57	Sunset
Standard Oil Co.	1	11	24	Maricopa 27	Sunset
Standard Oil Co.	2	11	24	Monarch 43	Sunset
August J. Bomke	12	29	20	1	Temblor
Canal Oil Co.	36	29	20	1	Temblor
Wesco Petroleum Co.	36	29	20	22	Temblor
Crusaders Oil Co.	21	10	10	1	Kern County
George F. Getty, Inc.	22	11	23	1	Kern County
X. H. Grusenmeyer	12	11	23	1	Kern County
Howland Oil Co.	2	29	28	10	Kern County
Modoc Petroleum Corp.	10	27	28	Mills-Kern 1	Kern County
Painted Hills Oil Assn.	19	31	22	F-1	Kern County
E. W. Spiers	31	32	23	1	Kern County
Standard Oil Co.	5	10	22	Kern Co. Lease 4 1	Kern County
Donald W. Whittier	5	11	24	Nichols Fried 1	Kern County
KINGS COUNTY:					
Chas. R. Blyth	34	21	17	Blyth 1	Kings County
George W. Shearer	18	23	19	1	Kings County
LOS ANGELES COUNTY:					
Fullerton Oil Co.	2	3	10	19	Brea Olinda
Associated Oil Co.	34	3	13	DeFrancis 6	Dominguez
Henderson Petroleum Corp.	34	3	13	Susana 1	Dominguez
Marland Oil Co.	3	4	13	Dominguez 5	Dominguez
Marland Oil Co.	3	4	13	Dominguez 6	Dominguez
Shell Co.	34	3	13	Manuel 1	Dominguez
Shell Co.	34	3	13	Manuel 2	Dominguez
Shell Co.	34	3	13	Manuel 3	Dominguez
Shell Co.	34	3	13	Manuel 4	Dominguez
Shell Co.	34	3	13	Manuel 5	Dominguez
Shell Co.	34	3	13	Reyes 19	Dominguez
Shell Co.	34	3	13	Reyes 20	Dominguez
Shell Co.	34	3	13	Reyes 21	Dominguez
Shell Co.	33	3	13	Reyes 22	Dominguez
Shell Co.	33	3	13	Reyes 23	Dominguez
Shell Co.	34	3	13	Reyes 24	Dominguez
Shell Co.	34	3	13	Reyes 25	Dominguez
Shell Co.	34	3	13	Reyes 26	Dominguez
Shell Co.	12	4	13	Virginia 1	Dominguez
Union Oil Co.	33	3	13	Callender 8	Dominguez
Union Oil Co.	33	3	13	Callender 9	Dominguez
Union Oil Co.	34	3	13	Hellman 8	Dominguez
Union Oil Co.	34	3	13	Hellman 9	Dominguez
Union Oil Co.	33	3	13	Hellman 10	Dominguez
Union Oil Co.	34	3	13	Hellman 11	Dominguez
United Oil Co. and Henderson Petroleum Corp.	3	4	13	Dominguez 3	Dominguez
United Oil Co. and Henderson Petroleum Corp.	3	4	13	Dominguez 4	Dominguez
Amazon Drilling Corp.	9	2	14	Baldwin 2	Inglewood
Standard Oil Co.	17	2	14	L. A. Inv. 1 3	Inglewood
Standard Oil Co.	8	2	14	McAllister 1	Inglewood
B. & H. Oil Co.	19	4	12	1	Long Beach
Bassett. Meyers & Rorex	24	4	13	1	Long Beach
R. M. Cook	29	4	12	Hall Weber 3	Long Beach
A. T. Jergins Syn.	29	4	12	2	Long Beach
Alvah M. Kaime	29	4	12	Flower State 1	Long Beach
Marland Oil Co.	14	4	13	Los Cerritos 1	Long Beach
Nevada-Signal Hill Oil Co.	24	4	13	2	Long Beach
Pan American Petroleum Co.	19	4	12	Butler 1	Long Beach
S. L. Pugh & F. G. Delaney	24	4	13	Dollarhide 1	Long Beach
W. R. Ramsey	28	4	12	B-5	Long Beach
South Slope Oil Co.	24	4	13	O'Donnell 36	Long Beach
McGinley Oil Co.	6	2	12	19	Montebello
Repetto Hills Petroleum Co.	34	1	12	1	Montebello
Crawford Syndicate Oil Co.	13	3	13	3	Newhall
Associated Oil Co.	20	3	13	Wanka 2	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 3	Rosecrans
Barnsdall Oil Co.	20	3	13	Rosecrans 3	Rosecrans
Barnsdall Oil Co.	20	3	13	Rosecrans 4	Rosecrans
Davis-Haines & Co.	7	3	13	1	Rosecrans
Federal Drilling Co.	7	3	13	Kanady 1	Rosecrans
Walter H. Fisher Corp.	7	3	13	8	Rosecrans
General Petroleum Corp.	18	3	13	Vaughn 2	Rosecrans
George F. Getty, Inc.	7	3	13	Athens 1	Rosecrans
George F. Getty, Inc.	7	3	13	Athens 2	Rosecrans
Hercules Gasoline Co.	7	3	13	1	Rosecrans
Hub Oil Co.	20	3	13	1	Rosecrans

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Marine Oil Corp.	7	3	13	33	Rosecrans
E. J. Miley	7	3	13	Athens 3	Rosecrans
E. J. Miley	7	3	13	Athens 4	Rosecrans
E. J. Miley	7	3	13	Athens 5	Rosecrans
E. J. Miley	7	3	13	Athens 6	Rosecrans
Mohawk Oil Co.	7	3	13	Bateman 1	Rosecrans
Mohawk Oil Co.	7	3	13	Brooks 1	Rosecrans
Pacific Petroleum Corp	7	3	13	Athens 3	Rosecrans
Roy W. Perkins	7	3	13	1	Rosecrans
Petroleum Midway Co., Ltd	7	3	13	Baskin 1	Rosecrans
Petroleum Midway Co., Ltd	7	3	13	Ducommun 1-A	Rosecrans
Petroleum Midway Co., Ltd	7	3	13	Folsom 1	Rosecrans
Petroleum Midway Co., Ltd	7	3	13	Fox Comm. 1	Rosecrans
Petroleum Midway Co., Ltd	7	3	13	Kreitz Comm. 1	Rosecrans
Petroleum Midway Co., Ltd	7	3	13	McCormick 1	Rosecrans
Sentinel Oil Co.	7	3	13	Athens 2	Rosecrans
Sentinel Oil Co.	7	3	13	Athens 3	Rosecrans
Tidal Oil Co	20	3	13	1	Rosecrans
Union Oil Co.	18	3	13	Howard Park 7	Rosecrans
Union Oil Co.	18	3	13	Howard Park 8	Rosecrans
Union Oil Co.	18	3	13	Jamison 1	Rosecrans
General Petroleum Corp.	5	3	11	Santa Fe 45-A	Santa Fe Springs
Union Oil Co.	6	3	11	Alexander 9	Santa Fe Springs
C. C. M. O. Co	16	4	14	Del Amo 31	Torrance
C. C. M. O. Co	16	4	14	Del Amo 32	Torrance
C. C. M. O. Co.	9	4	14	Del Amo 102	Torrance
C. C. M. O. Co.	15	4	14	Torrance 76	Torrance
C. C. M. O. Co.	15	4	14	Torrance 78	Torrance
C. C. M. O. Co	15	4	14	Torrance 84	Torrance
Consolidated Mutual Oil Co.	30	4	13	Empire 2	Torrance
Consolidated Mutual Oil Co	30	4	14	Oakley 60 1	Torrance
Fullerton Oil Co.	16	4	14	Cotton 9	Torrance
General Petroleum Corp.	30	4	13	20	Torrance
General Petroleum Corp.	8	4	14	Carson 5	Torrance
General Petroleum Corp.	25	4	14	Poggi 1	Torrance
General Petroleum Corp.	25	4	14	Poggi 2	Torrance
General Petroleum Corp.	25	4	14	Poggi 3	Torrance
General Petroleum Corp.	30	4	13	Poggi 4	Torrance
General Petroleum Corp.	30	4	13	Poggi 5	Torrance
George F. Getty, Inc	8	4	14	Torrance 25	Torrance
Marine Oil Corp	25	4	14	50	Torrance
Petroleum Midway Co., Ltd	8	4	14	R. J. Brown 1	Torrance
Petroleum Midway Co., Ltd	14	4	14	Carlson 4	Torrance
Petroleum Midway Co., Ltd	8	4	14	Churchill 1	Torrance
Petroleum Midway Co., Ltd	9	4	14	Craven Comm. 3	Torrance
Petroleum Securities Co.	19	4	13	Kleinmeyer 9-A	Torrance
Petroleum Securities Co.	19	4	13	Kleinmeyer 10-A	Torrance
Petroleum Securities Co.	19	4	13	Kleinmeyer 11-A	Torrance
Petroleum Securities Co	19	4	13	Kleinmeyer 13-A	Torrance
Petroleum Securities Co.	24	4	14	Kleinmeyer 14-A	Torrance
Petroleum Securities Co.	24	4	14	Kleinmeyer 32-A	Torrance
Petroleum Securities Co.	30	4	13	Kleinmeyer 17-B	Torrance
Petroleum Securities Co.	30	4	13	Kleinmeyer 18-B	Torrance
Selby & Root Co.	14	4	14	10	Torrance
Shell Co	9	4	14	2	Torrance
Shell Co.	24	4	14	Bluemle 6	Torrance
Shell Co	9	4	14	Torrance 3	Torrance
Standard Oil Co.	13	4	14	Dominguez 14	Torrance
Standard Oil Co	16	4	14	Flint 2	Torrance
Standard Oil Co.	25	4	14	Joughin 19	Torrance
Standard Oil Co.	25	4	14	Joughin 20	Torrance
Standard Oil Co	24	4	14	Kettler 4	Torrance
Standard Oil Co.	15	4	14	Marble Fee 28	Torrance
Standard Oil Co	15	4	14	Marble Fee 29	Torrance
Standard Oil Co.	15	4	14	Marble Fee 30	Torrance
Standard Oil Co.	15	4	14	Marble Fee 31	Torrance
Standard Oil Co.	15	4	14	Marble Fee 32	Torrance
Standard Oil Co.	16	4	14	Marble Fee 33	Torrance
Standard Oil Co.	22	4	14	Marble Lease 2 2	Torrance
Standard Oil Co.	16	4	14	Quandt 3	Torrance
Superior Oil Co.	19	4	13	Torrance 52	Torrance
Superior Oil Co.	24	4	14	Torrance 55	Torrance
Superior Oil Co.	25	4	14	Torrance 56	Torrance
Superior Oil Co.	30	4	13	Torrance 57	Torrance
Superior Oil Co.	19	4	13	Torrance 58	Torrance
Central Oil Co. of Los Angeles	23	2	11	74	Whittier
A. W. Duncan	18	4	11	Bixby Midfield 1	Los Angeles County
Chas. McFadden	8	3	14	1	Los Angeles County
Pan American Petroleum Co.	17	2	14	Sentous 1	Los Angeles County
J. J. Rekar	11	2	15	1	Los Angeles County
Shell Co.	11	5	12	Bryant 2	Los Angeles County
Shell Co	1	5	12	Bryant 3	Los Angeles County
Tonner Oil Co.	27	2	9	1	Los Angeles County

Company	Sec.	Twp.	Range	Well No.	Field
NAPA COUNTY:					
John E. Callahan	19	8	3	Prospect 1	Napa County
J. H. Carter	29	8	3	Prospect 1	Napa County
ORANGE COUNTY:					
Standard Oil Co.	13	3	11	Emery 40	Coyote Hills
Standard Oil Co.	17	3	10	M-C 101	Coyote Hills
Standard Oil Co.	19	3	10	M-C 102	Coyote Hills
Associated Oil Co.	2	6	11	Wardlow 2	Huntington Beach
Columbia Leasing & Development Co.	2	6	11	1	Huntington Beach
Pan American Petroleum Co.	11	6	11	Johnson 3	Huntington Beach
Petroleum Midway Co., Ltd.	11	6	11	Brown 5	Huntington Beach
Southern California Drilling Co.	2	6	11	Riggle 2	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 19	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 20	Huntington Beach
Standard Oil Co.	3	6	11	Huntington A 26	Huntington Beach
Standard Oil Co.	3	6	11	Huntington A 26-A	Huntington Beach
Standard Oil Co.	34	5	11	Huntington A 27	Huntington Beach
Standard Oil Co.	2	6	11	Huntington B 27	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B 28	Huntington Beach
Standard Oil Co.	4	6	11	Huntington B 29	Huntington Beach
Standard Oil Co.	2	6	11	Huntington E 9	Huntington Beach
Standard Oil Co.	12	6	11	Thomson 5	Huntington Beach
Bruce Oil Co.	27	6	10	1	Newport
A. J. Delaney	29	6	10	2	Newport
A. J. Delaney	29	6	10	3	Newport
N. E. Guthrie	28	6	10	1	Newport
Newport Petroleum Corp.	27	6	10	Tunnel 1	Newport
South Basin Oil Co.	28	6	10	4	Newport
Alfred Violette	24	6	10	1	Newport
John A. Yerkes	28	6	10	Elmer 1	Newport
Chicksan Oil Co.	32	3	9	2	Richfield
General Petroleum Corp.	28	3	9	Thompson 6	Richfield
Petroleum Midway Co., Ltd.	33	3	9	9	Richfield
Standard Oil Co.	32	3	9	Kramer 2 18	Richfield
Calny Oil Co.	36	3	8	Irvine 1	Orange County
RIVERSIDE COUNTY:					
L. R. Clark	3	3	2	1	Riverside County
R. B. Jackson	15	3	2	1	Riverside County
L. E. Smith	18	3	1	1	Riverside County
SAN BENITO COUNTY:					
Henry Harper	Rancho Antonis			9	San Benito County
SAN BERNARDINO COUNTY:					
Colton Terrace Oil Co.	25	1	5	1	San Bernardino Co.
Western Pacific Oil Co.	4	10	4	2	San Bernardino Co.
SAN DIEGO COUNTY:					
Todd & Clark	69	18	1	1	San Diego County
SAN LUIS OBISPO COUNTY:					
E. J. Miley	Lot 11, Rancho San Miguelito			1	San Luis Obispo Co.
Belridge Oil Co.	6	11	24	Judge 1	San Luis Obispo Co.
Carlisle Oil Co.	19	11	25	1	San Luis Obispo Co.
E. T. Edwards	22	31	21	4	San Luis Obispo Co.
J. T. Holland	22	32	22	1	San Luis Obispo Co.
SAN MATEO COUNTY:					
La Honda Oil Fields Assn.	-----	7	4	2	San Mateo County
SANTA BARBARA COUNTY:					
Union Oil Co.	------	9	34	Escolle 15	Casmalia
General Petroleum Corp.	6	9	33	Bradley 2	Santa Maria
Gilmore & Riverside Oil Co.	30	9	32	Henderson 4	Santa Maria
Rice Ranch Oil Co.	23	9	34	10	Santa Maria
Walter W. Gregg	Lot 17, Cerca Del Mar Subdivision			1	Santa Barbara Co.
S. W. Lea, et al.	------	4	25	2	Santa Barbara Co.
Sims Oil Interest_Lot 1, Rancho La Espada		6	35	1	Santa Barbara Co.
TULARE COUNTY:					
Hub Oil Co.	27	22	27	1	Tulare County
Hub Oil Co.	13	24	27	1	Tulare County
J. Mills Boal	3	23	27	1	Tulare County
Shannon Oil Co.	15	22	27	2	Tulare County

Company	Sec.	Twp.	Range	Well No.	Field
VENTURA COUNTY:					
Acme Petroleum Corp. and Cal-Mex. Oil & Rfg. Co.	2	3	19	Frey 1	Bardsdale
Montebello Oil Co.	4	3	19	Shiells 116	Bardsdale
J. A. Hess	4	1	20	1	Conejo
Rio Virgin Oil Syn.	33	2	20	9	Conejo
Rio Virgin Oil Syn.	33	2	20	10	Conejo
Torrey Petroleum Co.	32	4	18	3	Piru
Henderson & Robinson et al.	25	4	22	Henderson Union 16	Santa Paula
R. F. Labonge	1	4	20	Kentuck 12	Sespe
Oak Ridge Oil Co.	13	3	21	Harvey 15	South Mountain
Associated Oil Co.	27	3	23	Lloyd 17	Ventura
Associated Oil Co.	27	3	23	Lloyd 18	Ventura
C. E. Brain	9	3	23	1	Ventura
Shell Co.	28	3	23	Gosnell 9	Ventura
YOLO COUNTY:					
San Martinez Oil Co.	36	11	1	E. H. Bemmerley 1	Yolo County

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

MINING LAW.

By A. H. Ricketts, of the bar of the Supreme Court of the United States, of California and of Nevada.

Copyright, 1925, by A. H. Ricketts

Adjudicated Mining Terms and Phrases.*

TABLE OF CONTENTS.

I. Abandonment.
II. Absence of Discovery.
III. Abstract of Title.
IV. Accident.
V. Act of God.
VI. Adjacent.
VII. Adoption of Boundary Marks.
VIII. Adverse Claim.
IX. Adverse Intent.
X. Adit.
XI. Affidavit of Labor.
XII. Alien.
XIII. Annual Assessment Work.
XIV. Annual and Patent Expenditure.
XV. Anticline and Syncline.
XVI. Anticlinal and Fissure Veins.
XVII. Appropriation.
XVIII. Assay.
XIX. Assay Value.
XX. Assessment Labor.
XXI. Association.
XXII. Association Location.
XXIII. Barren Mine.
XXIV. Battery.
XXV. Bell Holes.
XXVI. Boss.
XXVII. Cap.
XXVIII. Carnotite.
XXIX. Character of Land.
XXX. Citizens.
XXXI. Claim.
XXXII. Claim Jumping.
XXXIII. Claims Held in Common.
XXXIV. Claimant.
XXXV. Classification of Land.
XXXVI. Computing Time.
XXXVII. Concentrate.
XXXVIII. Constructive Possession.
XXXIX. Contiguous.
XL. Contributory Negligence.
XLI. Copper Matte.
XLII. Copper Ore and Copper Concentrate.
XLIII. Corporation.
XLIV. Course of Employment.
XLV. Crevice.
XLVI. Cut.
XLVII. Declaratory Statement.
XLVIII. Deposits.
XLIX. Description Required in Other Cases.
L. Desert Lands.
LI. Dewater.
LII. Diatomaceous Earth.
LIII. Dip and Downward Course
LIV. Dump.
LV. Election.
LVI. Electro-Metallurgy.
LVII. Entry.
LVIII. Escape Way.
LIX. Exception or Reservation.
LX. Exemptions.
LXI. Experts.
LXII. Extralateral Rights.
LXIII. Float.
LXIV. Foreman.
LXV. Forfeiture.
LXVI. Fully Developed Mine.
LXVII. General Manager.
LXVIII. Giant.
LXIX. Going Concern.

---

*For additional "Terms and Phrases" see Report XX of the State Mineralogist, April, 1924, "Oil and Gas Rights," Part 1, page 105, and appropriate titles in work on "Mining Law," in preparation.

TABLE OF CONTENTS—(Concluded).

LXX. Government Ownership.
LXXI. Grizzlies.
LXXII. Headers.
LXXIII. Held in Common.
LXXIV. High Grading.
LXXV. Hydraulic Mining.
LXXVI. Improvement.
LXXVII. Independent Contractor.
LXXVIII. Indian Title.
LXXIX. Instrumentalities of Mining.
LXXX. Lands Valuable for Minerals.
LXXXI. Lapsed.
LXXXII. Lead.
LXXXIII. Lease by Federal Government.
LXXXIV. Located.
LXXXV. Location.
LXXXVI. Location and Patent.
LXXXVII. Location and Record.
LXXXVIII. Lode Location.
LXXXIX. Maps.
XC. Markings.
XCI. Master and Servant.
XCII. Meander Line.
XCIII. Metallic.
XCIV. Metallic Ore.
XCV. Metalliferous.
XCVI. Mine.
XCVII. Miner.
XCVIII. Mineral.
XCIX. Mineral Interests.
C. Mineral Lands.
CI. Mineral Right.
CII. Minerals Crude.
CIII. Mineral Surveyor.
CIV. Miners' Devices.
CV. Miners' Inch.
CVI. Miner's Lien.
CVII. Miner's Weight.
CVIII. Mining.
CIX. Mining and Milling.
CX. Mining Claim.
CXI. Mining District.
CXII. Mining Ground and Mining Land.
CXIII. Mining Purposes.
CXIV. Mining Right.
CXV. Mining Title.
CXVI. Models.
CXVII. Monuments.
CXVIII. Mucker.
CXIX. Name of Lode.
CXX. Negligence.
CXXI. Not Previously Known to Exist.
CXXII. Obliterated Corner.
CXXIII. Occupant.
CXXIV. Occupation.
CXXV. Official Plat of Survey.
CXXVI. Oil Flotation.
CXXVII. Oral Agreement to Locate.
CXXVIII. Ore.
CXXIX. Ore Dressing.
CXXX. Ore in Sight.
CXXXI. Ore Personal Property.
CXXXII. Other Valuable Deposits.
CXXXIII. Ouster.
CXXXIV. Outstroke and Instroke.
CXXXV. Pedis Possessio.
CXXXVI. Photographs.
CXXXVII. Pillars or Stumps.
CXXXVIII. Placers.
CXXXIX. Placer Location.
CXL. Placer Mining.
CXLI. Pop Shots.
CXLII. Preference.
CXLIII. Proceedings.
CXLIV. Process of Mining.
CXLV. Prospect Hole.
CXLVI. Prospecting and Mining.
CXLVII. Protestant.
CXLVIII. Provisional Locations.
CXLIX. Public Domain.
CL. Public Land.
CLI. Public Mineral Land.
CLII. Public Land and Public Use.
CLIII. Pusher-Jigger Boss.
CLIV. Quarry.
CLV. Real Property.
CLVI. Relinquishment.
CLVII. Rule of Approximation.
CLVIII. Saddle.
CLIX. Salines.
CLX. Salting.
CLXI. Salt Lick.
CLXII. Safe Appliances.
CLXIII. Safe Place.
CLXIV. Scrip.
CLXV. Seam.
CLXVI. Shift.
CLXVII. Shift Boss.
CLXVIII. Shoestring Location.
CLXIX. Skips.
CLXX. Slag.
CLXXI. Slope.
CLXXII. Smelter Returns.
CLXXIII. Smelting.
CLXXIV. Stabber.
CLXXV. Sludge.
CLXXVI. Stake.
CLXXVII. Stope.
CLXXVIII. Strikes.
CLXXIX. Superintendent.
CLXXX. System.
CLXXXI. Taking Timber Necessary to Support Their Improvements.
CLXXXII. This Vein.
CLXXXIII. Timbering.
CLXXXIV. Tool Nipper.
CLXXXV. Top and Apex.
CLXXXVI. To the Same Extent.
CLXXXVII. Trap.
CLXXXVIII. Trespass.
CLXXXIX. Tungsten.
CXC. Tunnel Claim.
CXCI. Tunnel Right.
CXCII. Tunnel Sites.
CXCIII. Unavoidable Casualties.
CXCIV. Unoccupied and Unappropriated Land.
CXCV. Usual Mining Privileges.
CXCVI. Vacant Land.
CXCVII. Veins and Lodes.
CXCVIII. Wash.
CXCIX. Water Rights.
CC. Waste.
CCI. Who Are and Who Are Not Co-owners.
CCII. Withdrawals.
CCIII. Working a Claim.
CCIV. Workmen's Compensation Acts.
CCV. Zone.

Introductory.

Throughout the reports of decisions of the various federal and state courts and of the Land Department, occasionally are found definitions of terms or phrases made by them and peculiar to the mining or mineral industries. Those of particular interest to mineral operators in the West are here collated.

I. Abandonment.

"Abandonment" of a mining claim is a matter of intent[1] which is to be arrived at from consideration of the acts of the parties.[2] Forfeiture results from failure to perform annual assessment work under the mining statutes, and the relocation of the land by another.[3]

II. Absence of Discovery.

It is a very common notion among prospectors in this country that if they sink a shaft, which they call a "discovery shaft" or run a cut or a tunnel for a few feet and put up their stakes, they acquire thereby some sort of an interest in the public domain, although within the limits of their shaft, cut or tunnel, there may be no indications whatsoever of a vein or mineral deposit and work has ceased. Whatever may be the comity in respect to this matter among miners and prospectors, as a matter of law such a location absolutely is worthless for any purpose.[4]

III. Abstract of Title.

An "abstract of title" is a paper prepared by a skilled searcher of records which should show an abstract of whatever appeared on the public records of the county affecting the title,[5] but an abstract of title of an unpatented mining claim merely is of the nature of memoranda which never show the true or, at least, the complete title.[6] Its examination, therefore, should, properly be coupled with personal inspection of the ground and its vicinity in order to ascertain, (1) that the mineral deposit (if any), warrants the character of the location made[7]; (2) that there is a valid "discovery" within the limits of the claim[8]; (3) that the notice of location has been posted upon the claim as and where required by local statute[9]; (4) that the location is so marked that its boundaries can be readily traced[10]; (5) that the end lines are parallel[11]; (6) that the location has not been laid across the vein or lode[12]; (7) or upon its "dip"[13]; (8) that there is no "known vein or lode" within a placer claim not separately located[14]; (9) that the required annual expenditure has been made[15]; that there is no conflicting surface claim.[16] The abstract of title is incomplete unless due note is made therein of the records of the local land office.[17]

---

[1] Black vs. Elkhorn Co., 163 U. S. 445. Peachy vs. Frisco Co., 204 Fed. 668.

[2] Lakin vs. Sierra Buttes Co., 25 Fed. 337.

[3] Goldberg vs. Bruschi, 146 Cal. 708, 81 Pac. 23.

Burden of proving abandonment is on party asserting it. Thornton vs. Phelan, —— Cal. A. ——, [illegible]

That the Supreme Court of the United States has not always recognized the distinction between abandonment and forfeiture: see Lavignino vs. Uhlig, 198 U. S. [illegible] [illegible] 30 Nev. 114, 93 Pac. 405, [illegible]

[4] [illegible] 29 Pac. 817. See Enhardt vs. Boars, 113 U. S. [illegible]

If such a location is followed by possession with a view of making discovery and work to that end diligently is prosecuted such possession cannot be disturbed by strangers. [illegible] see Union Oil Co. vs. Smith, 249 U. S. 348. McKenzie vs. Moore, 20 Ariz. 176 Pac. 568. See [illegible]

[5] Smith vs. Taylor, 82 Cal. 533, 23 Pac. 219; Taylor vs. Williams, 2 Colo. A. 559, 31 Pac. 505.

[6] Patterson vs. Hitchcock, 3 Colo. 533.

"An abstract of title merely is a memorandum or a concise statement of the conveyances and incumbrances appearing of record and affecting the title to real property, and its object is to enable the purchaser or his counsel to readily pass upon the validity of the title in question [illegible] is shown by an abstract or the public records a purchaser of real estate is charged with notice of the rights of persons in actual possession thereof." Foley vs. Brown, 85 Okla. 1, 204 Pac. 267; Duncan vs. Kelly, —— Okla. ——, 229 Pac. 425.

2. Abstract of Title of Patented Claim. An abstract of title of a patented mining claim should include all data of record in the local recorder's office and in the local land office.[18] It may thus be made to appear that the patentee holds in trust for pretermitted coowners, or other owners[19]; that dual patents have been issued[20]; that the property is not free from subsisting lien.[21] It is the date of the location notice and not the date of entry in the land office that determines priority of discovery and location of a patented lode claim.[22]

The patent may have issued after title had already passed out of the United States, in which case it is void.[23]

---

[7] Cole vs. Ralph, 252 U. S. 295; Harry Lode, 41 L. D. 403.

[8] Cole vs. Ralph, *supra*(7); see Fox vs. Myers, 29 Nev. 169, 86 Pac. 793.

[9] Butte Co. vs. Radmilovich, 39 Mont. 157, 101 Pac. 1078. As to state regulations see Butte City Co. vs. Baker, 196 U. S. 119; McCleary vs. Broaddus, 14 Cal. A. 60, 111 Pac. 125.

[10] Harper vs. Hill, 159 Cal. 253, 113 Pac. 162.

[11] Elgin Co. vs. Iron Co., 14 Fed. 377, aff'd in 118 U. S. 196.

[12] Flagstaff Co. vs. Tarbet, 98 U. S. 467.

[13] Larkin vs. Upton, 144 U. S. 21; but see Van Zandt vs. Argentine Co., 8 Fed. 75; Bunker Hill Co. vs. Shoshone Co., 33 L. D. 142.

[14] See McKay vs. Mesch, 274 Fed. 867; see, also, Reynolds vs. Iron Co., 116 U. S. 698; South Star Lode, 20 L. D. 204; but see South Butte Co. vs. Thomas, 260 Fed. 814, certiorari denied, 253 U. S. 486.

[15] See Last Chance Co. vs. Tyler Co., 61 Fed. 557. The statutory affidavit of expenditure presents *prima facie* evidence of the fact, Book vs. Justice Co., 58 Fed. 106, and forms a link in the chain of title. Thompson vs. Pack, 219 Fed. 624.

[16] Brannagan vs. Dulaney, 2 L. D. 744; Holt vs. Hazard, 10 Cal. A. 444, 102 Pac. 540, see Cook vs. Klonos, 164 Fed. 529.

The record of the certificate of location of a mining claim required by law does not necessarily disclose the title. The law prescribes what the certificate shall contain. This, however, gives the purchaser no information respecting conflicting claims. For this he is dependent on examination and inquiry. If a conflicting claim be ascertained the record still does not necessarily disclose the better title. Location and record still relate back to the date of discovery for the inception of title. Location and record may both be prior to those of a cross lode, and still the latter be the older title, by reason of an earlier discovery, perfected within the statutory time, of which the record gives no information. Patterson vs. Hitchcock, *supra*.(6)

[17] See U. S. vs. Wesely, 189 Fed. 276; Adams vs. Smith, 273 Fed. 652.

[18] Id. The register's final certificate of mineral entry (formerly receiver's final receipt) is not conclusive because it is subject to cancellation. Deffebach vs. Hawke, 115 U. S. 392; U. S. vs. Record Oil Co., 242 Fed. 746, but see El Paso Co. vs. McKnight, 233 U. S. 250; Silver King Co. vs. Conkling Co., 256 U. S. 162.

[19] Turner vs. Sawyer, 150 U. S. 578; Suessenbach vs. Bank, 5 Dak. 477; 41 N. W. 662: Thomas vs. Horst, 54 Mont. 260, 169 Pac. 731.

[20] See *supra*, note 17; see, also, Round Mt. Co. vs. Round Mt. Co., 36 Nev. 543, 138 Pac. 71.

[21] Forbes vs. Gracey, 9 Fed. Cas. 404; Butte Co. vs. Frank, 65 Pac. 1, 25 Mont. 344.

[22] Butte Co. vs. Frank, *supra* (21); When a patent issues it becomes operative as of date of the final receipt. U. S. vs. Detroit Co., 200 U. S. 335; Cassidy vs. Silver King Co., 199 Fed. 102.

[23] Davis vs. Weibbold, 139 U. S. 525; Francoeur vs. Newhouse, 40 Fed. 618; N. P. R. Co. vs. Barden, 46 Fed. 606. In Gleason vs. White, 199 U. S. 54, the court said: "By mistake of the Land Department, two patents have been issued. * * * It is one of those unfortunate mistakes which sometimes occur, and which necessarily throw confusion and doubt upon titles." In Adams vs. Smith, *supra* (17) both a mineral and an agricultural patent were issued partly embracing the same ground.

Placer patents always are doubtful, in theory at least.[24]

Personal examination of the ground covered by a patent is proper as, in the event of misdescription therein, the monuments fixed by the official survey govern.[25]

IV. Accident.

An "accident" as used in its popular sense is any unlooked for mishap or untoward event not expected nor designed.[26]

V. Act of God.

An "act of God" as known in the law is an irresistible superhuman cause, such as no reasonable human foresight, prudence, diligence, and care can anticipate.[27]

VI. Adjacent.

The word "adjacent," as generally defined and understood, means by, or near, and close, but not actually touching; and nonadjacent, representing the opposite situation, means not near, and not close.[28]

VII. Adoption of Boundary Marks.

In Campbell vs. McIntyre,[29] it is said: "We see no reason why the corner posts of an adjoining well-known placer claim, may not with the consent of the owner of such adjoining claim, be adopted as corner posts by the locator. Such adoption does not in any way tend to confusion as to the boundaries of the claim so located. It is not unlike the case of the adoption of the stakes of a prior location which has been abandoned as in Conway vs. Hart, 129 Cal. 480, 62 Pac. 44, and in Brockbank vs. Albion Co., 29 Utah 367, 81 Pac. 863. In Eaton vs. Norris, 131 Cal. 561, 63 Pac. 856, the court sustained claims where two adjoining locations were each marked by stakes set at the four corners, two thereof being stakes upon the dividing line and common to both claims."

VIII. Adverse Claim.

The signification of the words "adverse claim" as used in the mining law, is a claim filed in the United States Land Office opposing an application for patent for mining premises made by another person.[30]

---

[24] McKay vs. Mesch, *supra* (14); see Thomas vs. South Butte Co., 211 Fed. 107; Barnard Co. vs. Nolan, 215 Fed. 996; see Dahl vs. Raunheim, 132 U. S. 261.

[25] 32 Stats. 545; Coffee vs. Emigh, 15 Colo. 184, 25 Pac. 83. See Silver King Co. vs. Conkling Co., *supra*.(18) As to parties in possible adverse possession of the patented property see Reedy vs. Wesson, 1 Alaska 570; Wetzstein vs. Largey, 27 Mont. 212, 70 Pac. 717.

[26] Indian Creek Coal Co. vs. Calvert, 68 Ind. A. 474, 110 N. E. 522. It is a general rule that the happening of an accident carries with it no presumption of negligence on the part of the employer. Johnson vs. Silver King Co., 54 Utah 34, 179 Pac. 64. But it is the duty of a mine operator or other employer where an employee is injured to exercise ordinary care to secure and provide first aid for the injured employee and in the exercise of such care to secure for the injured employee surgical and medical treatment at the hands of competent physicians and surgeons. Hunicke vs. Meramic Co., 262 Mo., 560, 172 S. W. 43; see Cushman vs. Cloverland, 170 Ind. 402, 84 N.E. 759.

[27] Garrett vs. Beers, 97 Kan. 255, 155 Pac. 2; see Georgia Co. vs. Hall, 124 Ga. 324, 52 S. E. 679, 683, 684; Rosenwald vs. Oregon City Co., 84 Or. 15, 163 Pac. 831, Id. 164 Pac. 189; see, also, Lysaght vs. Lehigh Co., 254 Fed. 353.

[28] Brick Pomeroy Mill Site, 34 L. D. 324.

[29] 295 Fed. 47.

[30] McCowan vs. McClay, 16 Mont. 234, 40 Pac. 602; see Upton vs. Santa Rita Co., 14 N. M. 120, 89 Pac. 275.

IX. Adverse Intent.

The terms "claim of right," "claim of title" and "claim of ownership," when used in the books to express "adverse intent," mean nothing more than the intention of the dissessor to appropriate and use the land as his own to the exclusion of all others, irrespective of any semblance or shadow of actual title.[31]

X. Adit.

"Adit" is a term in mining used to denote the opening by which a mine is entered, or by which the water or ores are carried away; called also a drift.[32]

XI. Affidavit of Labor.

The object of the acts providing for the recording of "affidavits of labor" evidently is to fix some definite way in which the proof as to the performance of the work or expenses incurred in the making of improvements might be, in many cases, more accessible. Such acts simply provide the method of preserving *prima facie* evidence of the fact that such requirement has been fulfilled. The failure to comply with the terms of such an act will not work a forfeiture.[33]

XII. Alien.

The location by an alien and all the rights following from such location, are voidable, not void, and are free from attack by any one except the government.[34]

XIII. Annual Assessment Work.

The terms "assessment" and "annual assessment labor," refer to the annual labor required by § 2324 Rev. St., (5 U. S. Comp. St. p. 5525, § 4620), that being commonly called by miners the "annual assessment" or the "assessment work" and so described in many judicial opinions[35] and in at least two acts of Congress.[36] As applied to a mining claim, assessment work has nothing to do with locating or holding a claim before discovery. It is a condition subsequent to discovery and location to be performed in order to preserve the exclusive right of possession of a valid mining location upon which discovery has been made.[37]

XIV. Annual and Patent Expenditure.

Annual expenditure solely concerns adverse claimants of the same mineral land; goes to the right of possession and is determined by the courts, alone. The sufficiency of the expenditure of five hundred dollars as a condition precedent to the obtaining of patent is wholly within the jurisdiction of the Land Department.[38]

---

[31] Crowder vs. Doe, 162 Ala. 151, 50 So. 430; Bessler vs. Power River Co., 95 Or. 271, 185 Pac. 573.

[32] Gray vs. Truby, 6 Colo. 260; Electro Magnetic Co. vs. Auken, 9 Colo. 204, 11 Pac. 80. "In the United States, the word *tunnel* is used instead of adit in most cases, although properly a tunnel means a nearly horizontal excavation through the mountain, open at both ends, as a railroad tunnel." Schamel on Mining Law, page 19.

[33] Book vs. Justice, *supra*.(15) See Musser vs. Fitting, 25 Cal A. 746, 148 Pac. 536. It has been held that the claim is not open to relocation until after the expiration of the time allowed by law for the recordation of the affidavit. Jones vs. Peck, 63 Cal. A. 397, 218 Pac. 1030.

[34] Manuel vs. Wulff, 152 U. S. 505. See Ginaca vs. Peterson, 262 Fed. 904. The question of citizenship is immaterial and cannot be raised nor determined in suits between individuals except in "adverse suits." Holdt vs. Hazard, *supra*.(16)

[35] See El Paso Co. vs. McKnight, *supra* (18); Union Oil Co. vs. Smith, *supra*.(3)

[36] 28 Stats. 6; 30 Stats. 651.

[37] Union Oil Co. vs. Smith, *supra* (3); McLemore vs. Express Co., 158 Cal. 563, 112 Pac. 59; Borgwardt vs. McKitterick, 164 Cal. 650, 130 Pac. 417.

To "resume work" is to actually begin work in good faith and diligently prosecute the same to completion before an adverse relocation actually has been made. McCormick vs. Baldwin, 104 Cal. 229, 37 Pac. 903; Hirschler vs. McKendricks, 16 Mont. 211; 40 Pac. 290. There can be no resumption of work in Alaska. Ebner vs. Alaska Co., 210 Fed. 599.

XV. Anticline and Syncline.

An "anticline" is the crest of a ridge and the "syncline" the lower portion.[39]

XVI. Anticline and Fissure Veins.

The only difference between a vein in the form of a single anticlinal fold and the ordinary fissure vein is that the former has a crest, the limbs of which dip in opposite directions, while the latter has a terminal edge and a dip in but one direction.[40]

XVII. Appropriation.

The term "appropriation" in mining law means the posting of notice at or near the point where the ledge is exposed; next the recording of the notice; next the marking of the boundaries.[41]

XVIII. Assay.

An "assay" is a means of ascertaining the commercial value of a mineralized substance, as, for example, ore or black sand, or the product of a mill or smelter, either by a "fire" or a "wet" process,[42] and is termed "ordinary assays," "commercial assays," "specimen assays," "control assays" and "umpire assays."

XIX. Assay Value.

The term "assay value" means the standard value of gold everywhere.[43] An average "assay value" of several samples can not be taken as an absolute mathematical demonstration of the value of an orebody [44] nor is the assay return necessarily conclusive of the value of the thing assayed [45]; it may, however, tend to prove discovery.[46]

---

[38] Poore vs. Kaufman, 44 Mont. 248, 119 Pac. 785.

[39] Empire Co. vs. Tombstone Co., 131 Fed. 341. When strata dip like the roof of a house, the strata are spoken of as forming an anticline or saddleback. Page Advd. Textbook on Geology, IV, 83. Inclining in opposite directions from a central axis; applied to stratified rocks when they incline or dip from a central unstratified mass; or when in consequence of crust movements they have been folded or pressed together so that they dip each way from a central plane, which indicates the line parallel to which the folding has taken place; opposed to synclinal. Cent. Dict. There is nothing in the court definitions which militates against the crest of an anticlinal roll being the apex of a vein. Jim Butler Co. vs. West End Co., 35 Nev. 375, 158 Pac. 881, aff'd in 247 U. S. 450.

[40] Jim Butler Co. vs. West End Co., *supra*.(39)

[41] McCleary vs. Broaddus, *supra*.(9) See, generally, Gould vs. Markopa Co., 8 Ariz. 429, 76 Pac. 598.

But no location is complete without discovery therein. Cole vs. Ralph, *supra*.(7)

[42] Puget Co., 96 Fed. 90; Phipps vs. Hully, 18 Nev. 133, 1 Pac. 669. For difference in results of wet and fire assays see Puget Co., *supra;* Schamel on Mining Law, page 12. For a discussion, where assays were made from mine specimens, from car samples, and from mill or battery samples, see Fox vs. Hale & Norcross Co., 108 Cal. 369, 41 Pac. 308. For method of sampling and assay on ore sales see Chisholm vs. Eagle Co., 144 Fed. 670. For assay as evidence see Cole vs. Ralph, *supra* (7); Mudsill Co. vs. Watrous, 61 Fed. 163; People vs. Whalen, 154 Cal. 472, 98 Pac. 194; Healy vs. Rupp, 28 Colo. 102, 63 Pac. 319; Phipps vs. Hully, *supra*.

Assays do not have to be taken to establish the existence of a vein, nor warrant a location thereon. Iron Co. vs. Mike & Starr Co., 143 U. S. 404; Madison vs. Octave Oil Co., 154 Cal. 768, 99 Pac. 178; Muldrick vs. Brown, 37 Or. 185, 61 Pac. 429.

[43] Vietti vs. Nesbitt, 22 Nev. 390, 41 Pac. 151.

[44] Golden Reward Co. vs. Buxton, 97 Fed. 413; Pittsburg Co. vs. Glick, 7 Colo. A. 43, 42 Pac. 188. Mr. Costigan, in his work on Mining Law (page 108), says: "A 'mill run' is where a number of tons of supposedly representative ore are run through a mill to serve as an indication of the value of the ore in the mining claim. It is, of course, a far better test of the worth of the ore than an assay is, since an assay tests the value of only a very small piece of ore, and so is much less likely to be representative of the lode."

[45] Phipps vs. Hully, *supra* (42); see Mudsill Co. vs. Watrous, *supra* (42); Ormund vs. Granite Co., 11 Mont. 303, 28 Pac. 289; see, also, Cheesman vs. Shreve, 40 Fed. 787.

[46] Healy vs. Rupp, *supra* (42); see Cole vs. Ralph, *supra*.(7) The results of assays of rock taken from a mining claim long after the date of its location are competent evidence to show that the locators discovered a vein at the time of location. Southern Cross Co. vs. Europa Co., 15 Nev. 383.

XX. Assessment Labor.

The term "assessment labor" refers to the annual labor required of the locator of a mining claim after discovery and not to work before discovery.[47]

XXI. Association.

The term "association" usually means an unincorporated organization composed of a body of persons, banded together for some particular purpose, partaking in its general form and mode of procedure of the characteristics of a corporation.[48]

XXII. Association Location.

A location made by an association of persons in one location covering one hundred and sixty acres is not eight locations covering twenty-acres each. It is in law a single location, and as such a single discovery is sufficient to support such a location; also the only assessment work required is for a single claim.[49]

XXIII. Barren Mine.

A mine may be fully developed and yet, owing to the barrenness of the ore, it would be impossible to work it with profit.[50]

XXIV. Battery.

A "battery" is made of three stulls placed together and put in at the pitch of the vein, usually located a few feet apart, up and down, and crosswise of a stope.[51]

XXV. Bell Holes.

"Bell holes" are holes dug, or excavations made at the section joints of a pipeline for the purpose of repairs.[52]

XXVI. Boss.

The term "boss" means a master workman or superintendent, a director or manager.[53]

XXVII. Cap.

A "cap" is a square piece of plank or block wedged between the top of posts and the roof of a mine the better to hold the roof.[54]

XXVIII. Carnotite.

"Carnotite" essentially is a vanadate of uranium and potassium, but with other bases present also. It is found as a canary-yellow impregnation in sandstone in western Colorado and eastern Utah. By the reduction of carnotite ore radium, bromide or chloride, uranium oxide and vanadium oxide are obtained. The elemental substances radium, uranium and vanadium generally are classed as metals. However, they are not produced, marketed nor utilized in their elemental or metallic state but as the compounds above mentioned. The radium salts are used for scientific and medicinal purposes. Uranium is a heavy metal found chiefly in uraninite, carnotite, samarskite, and a few other rare minerals. Vanadium is a rare element, but acid and base forming, found in vanadates and allied to phosphorus. Carnotite is an impure vanadate of potassium and uranium. The elements of radium, uranium and vanadium are not dealt with in the metal market or the trades in their elemental form as metals, are not so produced or recovered immediately in the reduction of carnotite ore. While the two substances last named appear in some forms of special steels, the percentage so used is very small.

---

[47] Union Oil Co. vs. Smith, *supra.*(3)

[48] Pratt vs. R. C. Orphan Asylum, 46 N. Y. Supp. 1035; Ruple vs. DeJournette, 50 L. D. 139. See, also, U. S. vs. Trinidad Co., 137 U. S. 160.

[49] Con. Mutual Oil Co. vs. U. S., 245 Fed. 521. See U. S. vs. California Midway Oil Co., 279 Fed. 521. Reeder vs. Mills, 41 Cal. A. 426, 217 Pac. 562.

[50] People vs. Whalen, *supra.*(42) For a case involving an "exhausted mine" see Martin vs. Walsenburg Co., 200 Fed. 270. Lillibridge vs. Lackawanna Co., 264 Pa. St. 235, 107 Atl. 688.

[51] Lesh vs. Tamarack Co., 186 Mich. 399, 152 N. W. 1022.

[52] Moore vs. Hope Co., 76 W. Va. 651, 86 S. E. 565.

[53] Johnson vs. Butte & S. Co., 41 Mont. 158, 108 Pac. 1057; Applebee vs. Albany Co., 12 N. Y. S. 576.

[54] Big Branch Co. vs. Wrenchie, 160 Ky. 668, 170 S. W. 16.

The compounds or oxides of the two elements are the forms used in the production of such steels. It follows therefore that carnotite is not a metalliferous mineral and a mineral location thereof within a petroleum withdrawal can not stand.[55]

XXIX. Character of Land.

The question of the "character of land" can be raised only by the United States or those claiming under them[56] and conclusively is determined in and by the Land Department.[57] The question usually arises at the instance of some party connected with the paramount title, who claims the land to be nonmineral.[58] The Land Department, however, is authorized at any time before patent to inquire whether the original entry was in conformity to law.[59] A patent duly issued by the Land Department sets at rest for all time the question of the mineral or nonmineral character of the land described therein.[60]

XXX. Citizens.

Mining claims within the United States may be located by citizens of the United States and by those who have declared their intention to become such citizens.[61]

2. Corporations. A corporation existing by virtue of the laws of the United States or of a state or territory of the United States is a citizen of the United States.[62]

3. Alaska. Native born citizens of the Dominion of Canada are accorded certain reciprocal mining rights and privileges within Alaska.[63]

4. Philippine Islands. Citizens of the United States and citizens of the Philippine Islands may make mining locations therein.[64]

5. Land Office Employees. Citizens of the United States who are employed in the General Land Office are prohibited by statute from in any manner acquiring public land.[65]

---

[55] Con. Ores Co., 46 L. D. 468.

[56] Ryan vs. Granite Hill Co., 29 L. D. 522; Lorenz vs. Waldron, 96 Cal. 243, 31 Pac. 54.

[57] Burfenning vs. Chicago Co., 163 U. S. 321; Standard Co. vs. Habishaw, 132 Cal. 115, 64 Pac. 113. See Kirk vs. Olsen, 245 U. S. 225; Day, 50 L. D. 24.

[58] Chrisman vs. Miller, 197 U. S. 313; aff'g 140 Cal. 440, 73 Pac. 1083, 74 Pac. 444, Book vs. Justice Co., *supra* (15); Olive Land Co. vs. Olmstead, 103 Pac. 568; Mutchmor vs. McCarty, 149 Cal. 603, 87 Pac. 85.

[59] Kirk vs. Olson, *supra* (57); Nichols & Smith, 46 L. D. 26. See Cowell vs. Lammers, 21 Fed. 200. See, also, Wyoming vs. U. S., 255 U. S. 489.

[60] Thomas vs. Horst, *supra.* (19)

[61] Gleeson vs. Martin White Co., 13 Nev. 442.

[62] McKinley vs. Wheeler, 130 U. S. 630; Doe vs. Waterloo Co., 70 Fed. 455.

[63] See Instructions, 32 L. D. 424.

[64] 32 Stats. 697; amended, 33 Stats. 692.

[65] Rev. Stat. § 452, Baltzell, 29 L. D. 333; Contzen, 38 L. D. 346.

XXXI. Claim.

The word "claim" in mining parlance when used as a noun has a definite meaning, denoting when coupled with the name of a miner, a particular piece of ground to which he has a recognized, vested and exclusive right of possession for the purpose of extracting metals and minerals therefrom.[66] The term is applied indifferently to both lode and placer claims.[67]

XXXII. Claim Jumping.

The location of a mining claim on supposably excess ground within the staked boundaries of an existing location on the theory that the law governing the manner of making the original location has not been complied with is called "claim jumping."[68]

XXXIII. Caims Held in Common.

The phrase "held in common" means a claim whereof there are more owners of a claim than one, while the use of the words "claims held in common," on which work done on one of such claims shall be sufficient, means that there must be more than one claim so held, in order to make a case where work on one of them shall answer the statutory requirement as to all.[69]

XXXIV. Claimant.

The word "claimant" as used in the federal mining law, means "locator."[70]

XXXV. Classification of Land.

There is no certain, well-defined obvious line of demarcation between mineral and nonmineral land.[71] No land can be valuable mineral land unless it contains a deposit of mineral in some form, metalliferous or nonmetalliferous in quantity sufficient to justify expenditures in the effort to extract it.[72]

XXXVI. Computing Time.

In "computing time," when notice is given in land office proceedings, the first day is excluded and the last day included.[73]

XXXVII. Concentrate.

In mining the term "concentrate" means to separate ore or metal from its containing rock or earth. The concentration of ores always proceeds by steps or stages. Thus the ore must be crushed before the mineral can be separated, and certain preliminary steps, such as sizing and classifying, must precede the final operations, which produce the finished concentrates.[74]

---

[66] N. P. R. Co. vs. Sanders, 49 Fed. 129. The word "claim" as used in the law affecting adversary patent proceedings refers to an unpatented claim. Iron Co. vs. Campbell, 135 U. S. 286; Wright vs. Town, 13 Wyo. 506, 81 Pac. 649.

[67] Sweet vs. Webber, 7 Colo. 443, 4 Pac. 752; see Bay State Co. vs. Brown, 21 Fed. 167.

[68] Nelson vs. Smith, 42 Nev. 302, 176 Pac. 265; see Stock vs. Plunkett, 181 Cal. 193, 183 Pac. 657; Murphy vs. Cobb, 5 Colo. 281; Arnold vs. Baker, 6 Neb. 134.

[69] Chambers vs. Harrington, 111 U. S. 352; Union Oil Co. vs. Smith, *supra.*(3)

[70] Garden Gulch Placer, 38 L. D. 31.

[71] Ah Yew vs. Choate, 24 Cal. 562.

[72] Deffeback vs. Hawke, *supra* (18); N. P. R. Co. vs. Soderberg, 188 U. S. 526; Brophy vs. O'Hare, 34 L. D. 596.

[73] Bonesell vs. McNider, 13 L. D. 286; see Waterhouse vs. Scott, 13 L. D. 718; and see Rousseau, 47 L. D. 590. Where the relative priority of conflicting locations depends upon the exact hour of the day of filing for record, fractions of a day are taken into account. See Washington Co. vs. O'Laughlin, 46 Colo. 503, 105 Pac. 1092.

[74] The Santa Clara, 181 Fed. 725.

XXXVIII. Constructive Possession.

"Constructive possession" is that possession which the law annexes to the legal title or ownership of property, when there is a right to the immediate actual possession of such property but no actual possession.[75]

XXXIX. Contiguous.

The term "contiguous" means touching sides, adjoining, adjacent. Two tracts of land touching only at a point, are not contiguous.[76]

XL. Contributory Negligence.

The term "contributory negligence" means that the law imposes upon every person the duty of using ordinary care for his own protection against injury.[77] It is not synonymous with assumption of risk.[78]

XLI. Copper Matte.

"Copper matte" is a product obtained by smelting copper sulphide ores. It mainly is cuprous sulphide, with a varying quantity of ferrous sulphide.[79]

XLII. Copper Ore and Copper Concentrate.

"Copper ore" and "copper concentrates" are not interchangeable, but mean two distinct and different things. "Copper ore" is the raw material of nature: and "copper concentrate" is the product of any one of a number of forms of concentration processes. The concentrates invariably are more valuable than the ore, being the natural product after it has been mechanically treated. The mechanical operation involves important changes in the natural product. In the first place it is pulverized, and converted from a solid, rocky condition to a fine, powdered condition. Then water or oil is added, and a chemical change takes place, so that the chemical analysis of the concentrates is different from that of the crude ore from which the concentrate is made, and there is a sifting out from the metallic content of the ore of the mineral waste content of the ore. It converts a noncommercial ore into a commercial product.[80]

---

[75] Southern Ry. Co. vs. Hall, 145 Ala. 224, 41 So. 136. Where a mining claim lacks none of the essential elements of a location and the requisite expenditure is made thereon it can be held by constructive possession. Harris vs. Equator Co., 8 Fed. 863. Gowdy vs. Kismet Co., 22 L. D. 628. A miner is not expected to reside upon his claim nor to cultivate the ground nor to inclose it. Table Mt. Co. vs. Stranahan, 20 Cal. 210; see English vs. Johnson, 17 Cal. 107.

[76] Hidden Treasure Mines, 35 L. D. 485, cited with approval in Anvil Co. vs. Code, 182 Fed. 205.

[77] Beers, vs. Housatonic Co., 19 Conn. 466; Graham vs. Penn. Co., 139 Pa. St. 149, 21 Atl. 151; Gulf Co. vs. Shieder, 88 Tex. 152, 30 S. W. 902; see, also, De Honey vs. Harding, 300 Fed. 696. Neither the defense of contributory negligence nor the defense of assumption of risk can arise unless the defendant in the action—a mine operator—has been guilty of negligence which, but for want of both these defenses, would render the operator liable for damages to an injured miner, as in the absence of such negligence there is nothing against which to make such a defense; but if there is evidence from which a jury may find the operator guilty of such negligence, then either of these defenses, if it exists in fact, is available to the defendant operator to defeat a recovery. Osage Co. vs. Sperra, 42 Okla. 726, 142 Pac. 1040. A miner whose duty it was to push loaded cars of ore from the mine to the dumping place and who instead of pushing or following the loaded car got upon the car to ride down a steep grade and who by reason of the velocity attained by the car was injured by reason of selecting the dangerous method of tramming the ore, was guilty of such contributory negligence as would prevent a recovery. Dilley vs. Primos Co., 64 Colo. 361, 171 Pac. 1147.

[78] Dolese Bros. Co. vs. Kahl, 203 Fed. 627.

[79] Pierce Smith Co. vs. United Verde Co., 293 Fed. 109.

[80] The Santa Clara, *supra*.[74]

XLIII. Corporation.

A "corporation" is a legal entity and can have no greater rights than an individual in acquiring public lands.[81] Hence a corporation, regardless of the number of its stockholders, may lawfully locate no greater area than is allowable in the case of an individual.[82]

2. Citizenship. A corporation is a citizen of the state within which it is incorporated[83] and it is conclusively presumed that all of its stockholders are citizens.[84]

3. Ultra Vires Location. An "ultra vires location" is valid and until inquest of office found.[85]

XLIV. Course of Employment.

The term "course of employment" means where a miner is working within the period of the employment at a place he may reasonably be and while he is reasonably fulfilling the duties of his employment or is engaged in doing something incidental thereto.[86]

XLV. Crevice.

"Crevice" is a word sometimes applied to a mineral-bearing vein.[87]

XLVI. Cut.

The word "cut" may have a meaning other than that employed in mining but when it is used in conjunction with "shaft" and "drift" it means a surface opening in the ground intersecting a vein and never is intended to apply to a ditch or trench temporarily open for the purpose of laying sewer pipe.[88]

XLVII. Declaratory Statement.

A "declaratory statement," in practical mining operations, is a term applied to the statutory certificate of location, and is a certificate or statement of the location, containing a description of the mining claim, verified by the oath of the locator, performing, when recorded, a permanent function. It is the beginning of the locator's paper title, is the first muniment of such title, and is constructive notice to all the world.[89]

---

[81] McKinley vs. Wheeler, *supra* (62); Igo Placer, 38 L. D. 281; Bakersfield Co., 39 L. D. 460.

[82] Gird vs. California Oil Co., 60 Fed. 531; Nome Co. vs. Snyder, 187 Fed. 385; Mitchell vs. Cline, 84 Cal. 409, 24 Pac. 164; Miller vs. Chrisman, *supra*.(58) Any device whereby one person is to acquire more than twenty acres or an association more than one hundred and sixty acres by one location is a violation of law, a fraud upon the government and without legal support. U. S. vs. Brookshire Co. 242 Fed. 718; U. S. vs. Midway Oil Co., 259 Fed. 343.

[83] North Noonday Co. vs. Orient Co., 1 Fed. 522; see Doe vs. Waterloo Co. *supra* (62); Jackson vs. White Cloud Co., 36 Colo. 122, 85 Pac. 639.

[84] Doe vs. Waterloo Co. *supra*.(62)

[85] Rose Claims, 22 L. D. 83; see Union Bank vs. Matthews, 98 U. S. 628.

[86] Granite Co. vs. Willoughby, 70 Ind. A. 77, 123 NE 195; see, also, Kish vs. California Ass'n. 190 Cal. 246, 212 Pac. 27.

[87] St. Anthony Co. vs. Shaffra, 138 Wis. 507, 120 N. W. 238; see Terrible Co. vs. Argentine Co., 89 Fed. 583; see, also, Barnard Co. vs. Nolan, *supra* (20); Beals vs. Cone, 27 Colo. 473, 62 Pac. 948; McShane vs. Kenkle, 18 Mont. 208, 44 Pac. 979; Muldrick vs. Brown, *supra* (42); Fox vs. Myers, *supra*.(8)

[88] McLaughlin vs. Bardsen, 50 Mont. 177, 145 Pac. 956.

[89] Gird vs. California Oil Co., *supra* (82) Magruder vs. Oregon Co., 28 L. D. 177; Pollard vs. Shively, 5 Colo. 312; Metcalf vs. Prescott, 10 Mont. 283, 25 Pac. 1037; McCowan vs. McClay, *supra* (30); Hickey vs. Anaconda Co., 33 Mont. 62, 81 Pac. 806. See Cole vs. Ralph, *supra*.(7)

The federal mining law does not use the term "declaratory statement," but by usage among miners the term has reference to the recorded certificate required by local statute or local rule. There is a clear distinction between a posted notice and the declaratory statement. Peters vs. Tonopah Co. 120 Fed. 589; Sanders vs. Noble, 22 Mont. 110, 55 Pac. 1037.

XLVIII. Deposits.

The term "valuable mineral deposits" in section 2319 Revised Statutes, the expression "lands valuable for minerals" in section 2318 Revised Statutes, and the word "mines" in section 2323, Revised Statutes, the term "valuable deposits" in section 2325, Revised Statutes, as well as the expression "mines of gold" in section 2392, Revised Statutes, all refer to substantially the same thing and embrace both veins or lodes and placers.[90]

XLIX. Description Required in Other Cases.

In patent proceedings the words "and the description required in other cases" contemplate a plat and field notes of the survey properly made and approved by the surveyor-general as required in applications for lode claims.[91]

L. Desert Lands.

"Desert lands" are all lands exclusive of timber lands and mineral lands which will not, without irrigation, produce some agricultural crop.[92]

LI. Dewater.

"Dewater" is a term applied to pumping and removing water from a mine.[93]

LII. Diatomaceous Earth.

"Diatomaceous earth," also called infusioral earth and kieselguhr, is a light earthy material which from some sources is loose and powdery and from others is more or less firmly coherent. It may resemble clay or chalk in physical properties, but can be distinguished at once from chalk by the fact that it does not effervesce when treated with acids. It generally is white or gray in color, but may be brown or even black when mixed with much organic matter. It is made up of remains of minute aquatic plants and is composed chemically of hydrous silica.

Owing to its porosity it has great absorptive powers and high insulating efficiency and is an effective filter. Its hardness, the minute size, and the shape of its grains make it an excellent metal polishing agent. Diatomaceous earth undoubtedly is a mineral substance and if found in such quantities and qualities as to render lands containing such deposits valuable, it constitutes a valuable deposit under the mining laws.[94]

LIII. Dip and Downward Course.

The words "dip" and "downward course" are synonymous.[95] The dip in different veins and in the same vein sometimes varies from a perpendicular to the earth's surface to an angle, perhaps, only a few degrees below the horizon. The dip is spoken of from three different points of view; (1) As to its inclination from a perpendicular to a horizontal, as so many degrees from the perpendicular or from the horizontal. A vein is thus described as having a dip of twenty degrees, thirty degrees, etc.; (2) As to the direction it takes from the strike or apex, by the points of the compass. If the strike were due east or west, and the vein in its course downward departed from the perpendicular at an angle so that a perpendicular shaft sunk at the apex would leave the vein to the north of such shaft, the dip in this point of view, would be said to be due north, or, the conditions reversed, due south. In this respect the dip—that is the direction of the dip—is said to be, and is, at right angles to the strike; (3) The dip is again spoken of as the portions of the vein successively encountered in getting down and away from the apex. The miner follows the dip when he works downward, leaving the apex further from and above him at each advance. He follows the strike when he works lengthways of the vein on a level: that is when he is advancing along the vein, rising neither toward the surface of the ground nor descending, but going on a level with the plane of the earth's surface. A failure to distinguish these three views of the dip in using the word sometimes leads to confusion. For the sake of definition let us call the dip from the first point of view the inclination dip, the second the compass dip, and the third the practical dip, for this is the practical idea of the miner when he speaks of following his dip.

---

[90] Hawke vs. Deffebach, 4 Dak. 33, 22 N. W. 480; see, also, Pacific Coast Co. vs. N. P. R. Co., 25 L. D. 243; Forsythe vs. Weingart, 27 L. D. 680. The term "valuable mineral deposits" includes diamonds (14 Op. Atty. Gen. 115; see, also, Kentucky Co. vs. Kentucky Co., 141 Ky. 97, 132 S. W. 3997), and also guano, Richter vs. Utah, 27 L. D. 97.

[91] Harsh, 2 L. D. 706; Donlan, 39 L. D. 354.

[92] 19 Stats, 377, § 2; see, also, Peoples, 48 L. D. 554. Desert land claimants will rarely come in conflict with mining claimants. In such event contests are decided on the same principle as homestead entries. See 1 Lind. Mines (3 ed.), § 212; Costigan on Mining Law, page 88; Schamel on Mining Law, page 106. For validity of assignment by entryman see Eymann vs. Wright, 177 Cal. 144, 169 Pac. 1037. See, also, Ruple vs. De Journette, *supra.*(48)

[93] Mackie-Clemens Co. vs. Brady; 202 Mo. A. 551, 208 S. W. 152. See Evalina Co. vs. Yosemite Co., 15 Cal. A. 714, 115 Pac. 946; and see Miller vs. Chester Co., 129 Pa. St. 81, 18 Atl. 565.

[94] C. P. R. Co. 45 L. D. 223.

[95] Duggan vs. Davey, 4 Dak. 110, 26 N. W. 901.

Under this definition, a vein absolutely perpendicular to the plane of the earth's surface, an occurrence rarely if ever encountered, has no inclination dip nor compass dip. It has only the practical dip: but in actual mining, veins possess a dip from all three points of view. Keeping these definitions in mind, some expression of courts and argument of counsel become more clear. The word "dip" is not used in the mining act of congress. The expression there is "course downward". Dip is the miner's word which has attained the signification above defined.[96]

LIV. Dump.

The intention with which the owner of the property extracts the ore from the ground, and the purpose and intention of the owner with which it is placed on the "dump," is controlling in arriving at a solution of the question whether the ore after having been extracted and placed in the "dump" is personalty or realty.[97]

LV. Election.

The offer contained in an option contract is called "election" and it gives rise to a subsequent contract between the parties to buy or sell, or perform whatever other acts have been specified in the option contract.[98] The particular act or acts which constitute an "election" may be fixed by the terms of the option, as also the time when, the place where, and the person to whom it shall be made.[99]

---

[96] King vs. Amy Co., 9 Mont. 543, 24 Pac. 202.

[97] Steinfeld vs. Omega Co., 16 Ariz. 230, 141 Pac. 847. That a dump is considered a part of the mine, see Savage vs. Nixon, 209 Fed. 124. See, also, Nordstrom vs. Silverstein-Johnsen Co., 5 Alaska 208.

[98] Penn. Co. vs. Smith, 207 Pa. St. 210, 56 Atl. 426; see, also, Flickinger vs. Heck, 187 Cal. 114, 202 Pac. 1045. Cline vs. Hall.—— Okla ——, 232 Pac. 31.

[99] Flickinger vs. Heck, *supra* (98); see, generally, Craig vs. White, 187 Cal. 489, 202 Pac. 648.

LVI. Electro-Metallurgy.

"Electro-metallurgy" is a term characterizing all processes in which electricity is applied to the working of metals.[100]

LVII. Entry.

1. The term "entry" as applied in the appropriation of public land means that act by which an individual acquires an inceptive right to a portion of the unappropriated soil of the country.[101]

2. Certificate of Entry. The "certificate of entry" now is issued by the Register of the proper land office, instead of by the Receiver as formerly, to the party entitled by law thereto.[102]

3. Certificate Equivalent to Patent. A certificate of entry is equivalent to a patent issued.[103] When in fact the patent does issue it relates back to the inception of the right of the patentee, and cuts off intervening claimants.[104] In the meantime the government holds the naked legal title in trust for the entryman.[105]

4. Effect of Patent. An entry sustained by a patent is conclusive evidence that there had been, at the time of the entry, a valid location [106]; but the patent and entry do not conclusively evidence the length of time before the entry that such location existed. The time the location was made is an open question of fact, provable like any other fact.[107] A failure to perform the annual assessment work after entry does not subject the claim to relocation, as a delay in issuing the patent does not affect the rights of the applicant.[108]

5. Cancellation of Entry. It is the province of the Land Department to investigate the legality of an entry prior to patent and cancel the certificate of entry, in whole or in part, so as to conform the entry to the law.[109] In other words, the Land Department, as a specially constituted tribunal, has jurisdiction over mining locations enabling it to declare them valid as well as invalid in accordance with the facts and the appropriate law as found and determined by it after due notice and hearing.[110] If the cancellation is based upon a misconstruction of the law, it can be corrected by the courts.[111]

6. Repayment. An applicant whose application, entry, or proof has been rejected is entitled to repayment when neither such applicant nor his legal representatives shall have been guilty of any fraud or attempted fraud in connection with such application.[112] The demand must be verified and made through the local or general land office.[113]

---

[100] Edison Co. vs. Westinghouse Co., 55 Fed. 508. See, also, Cowles Co. vs. Lowney, 79 Fed. 331.

[101] Sturr vs. Beck, 133 U. S. 541; Mason vs. U. S., 260 U. S. 545; see Witherspoon vs. Duncan, 71 U. S. 210; Wilson, 48 L. D. 380.

[102] Witherspoon vs. Duncan, *supra.*(101)

[103] Benson Co. vs. Alta Co., 145 U. S. 428; Cranes Co. vs. Scherrer, 134 Cal. 353, 66 Pac. 487; Davis vs. Fell, 59 Cal. A. 438, 211 Pac. 30.

[104] Stark vs. Starrs, 73 U. S. 402; Amador Median Co. vs. South Spring Hill Co., 36 Fed. 668.

[105] Witherspoon vs. Duncan, *supra* (101); see U. S. vs. Record Oil Co., *supra.*(18)

[106] Creede Co. vs. Uinta Co., 196 U. S. 337; Last Chance Co. vs. Tyler Co., 61 Fed. 557.

[107] El Paso Co. vs. McKnight, *supra* (18); Lawson vs. U. S. Co., 207 U. S. 1; Creede Co. vs. Uinta Co., supra (106); Hickey vs. Anaconda Co., 33 Mont. 46; 81 Pac. 806; Washoe Co. vs. Junila, 43 Mont. 178; 115 Pac. 917; see, also, Butte & S. Co. vs. Clark-Montana Co. 249 U. S. 12.

[108] Benson vs. Alta Co. *supra* (105); Neilson vs. Champagne Co., 111 Fed. 657, Marburg Lode, 30 L. D. 202; Batterton vs. Douglas Co., 20 Ida. 764; 120 Pac. 827; see South End Co. vs. Tinney, 22 Nev. 19, 35 Pac. 89.

[109] Pfau, 39 L. D. 359; see, generally, Hamilton, 38 L. D. 597.

[110] Clipper Co. vs. Eli Co., 194 U. S. 220; Cameron vs. U. S. 252, U. S. 450; Lane vs. Cameron, 45 App. D. C. 404; Yard, 38 L. D. 59; Nichols & Smith, *supra* (59); Pollock 48 L. D. 5.

[111] Hawley vs. Diller, 178 U. S. 476.

[112] Kern Co., 48 L. D. 367; see Hawk, 41 L. D. 350.

[113] Repayment, 39 L. D. 141.

7. Repayment of Excessive Deposits. It now is usual for the surveyor-general to make immediate repayment of any excess of an amount deposited for the platting of a mineral claim and other office work in his office.[114]

LVIII. Escape Way.

The term "escape way" as used in a mining statute means a passage way leading from the inside to the outside of the mine through which miners in the mine could escape.[115]

LIX. Exception or Reservation.

A "reservation" or "exception" of the minerals in a tract of land conveyed is a separation of the estate in the minerals from the estate in the surface, and it makes no difference whether the word used is "excepted" or "reserved".[116]

LX. Exemptions.

Exemption laws are grants of personal privileges to debtors, which may be waived by contract or surrender or by neglect to claim before sale.[117]

LXI. Experts.

An "expert" is defined to be one who is skilled in any particular act, trade or profession, being possessed of peculiar knowledge concerning the same. Strictly speaking, an "expert" in any science, art or trade, is one who by practice or observation has become experienced therein.[118]

LXII. Extralateral Rights.

What in mining cases is termed the "extralateral right" is a creation of the mining laws of congress, and to learn what it is we must look to them rather than to some system of law to which it is a stranger. Besides, as congress has plenary power over the disposal of the mineral bearing public lands, it rests with it to say to what extent, if at all, the right to pursue veins on their downward course into the earth shall pass to and be reserved for those to whom it grants possessory or other titles in such lands.[119]

---

[114] See Hanson, 38 L. D. 169, 469.

[115] Roberts vs. Tennessee Co., 255 Fed. 469.

[116] De Moss vs. Sample, 143 La. 243, 78 So. 486.

[117] Spitley vs. Frost, 15 Fed. Cas. 299; see Conde vs. Sweeney, 16 Cal. A. 160, 116 Pac. 319.

[118] Turner vs. Haar, 114 Mo. 335, 21 S. W. 737. The scope of "expert evidence" is not restricted to matters of science or skill, but to any subject in respect to which one may derive, by experience, special and peculiar knowledge. Zarnick vs. Reiss Co., 133 Wis. 290, 113 N. W. 752; Hamann vs. Milwaukee Co., 127 Wis. 550, 106 N. W. 1081. The positive testimony of miners who mined the ore and developed the mine and the engineers and others who made actual surveys of the mine involved in a controversy as to extralateral rights must be taken for more than the speculative theories of experts on the geology and formation of ore bodies and the mineralization of veins. Physical facts should be given greater weight than mere expert opinion and speculative theories. Alameda Co. vs. Success Co., 29 Ida. 618, 161 Pac. 868. See, also, Northern California Co. vs. Waller, 174 Cal. 277, 163 Pac. 214, Ward vs. Massachusetts Co., —— Cal A. —— 228 Pac. 363; People vs. Boggess, —— Cal. ——, 228 Pac. 148.

[119] Jim Butler Co. vs. West End Co., *supra*.(29)

Under the common law a mineral claimant would be entitled only to what might be over and under the surface of his mining claim, carved out by the extreme lines of location extended downward indefinitely; but the mining statute qualifies or enlarges this right in one respect only to the extent that the locator may follow the lode or vein from the apex found within the surface ground of his claim, on its dip, to and depth, although in its course downward it may depart from the perpendicular and enter the land adjoining. This right to follow the vein beyond the side line does not apply on the course or strike of the vein. Whilden vs. Maryland Co., 38 Cal. A. 270, 164 Pac. 908. See, also, Bourne vs. Federal Co., 243 Fed. 468.

LXIII. Float.

The term "float" or "float rock" means bunches, blotches, pieces, or boulders of quartz or rock lying detached from, or resting upon the earth's surface without any walls.[120]

LXIV. Foreman.

A "foreman" is one who takes the lead in the work, and may or may not have authority over his fellow workmen, and because he takes the lead and points out the work to be done, it does not necessarily follow that he stands in the place of the master.[121]

LXV. Forfeiture.

The term "forfeiture" does not appear in the federal mining law providing for the relocation of mining claims; but the courts employ the term as a comprehensive word indicating a legal result flowing from a breach of condition subsequent, subject to which the locator acquires his title.[122] The term "forfeiture" as used in the mining customs and codes of California means the loss of a right previously acquired to mine a particular piece of ground, by neglect or failure to comply with the rules and regulations of the bar or diggings in which the ground is situated; as "abandonment" in its common-law sense, merely is a question of intention, and takes place when the ground is left by the locator, without any intention of returning or making any future use of it, independently of any mining rule or regulation. A right to hold and work a mining claim when acquired may be lost by a failure or neglect to comply with the rules or regulations of the miners, relative to acquisition and tenure of claims, in force in the bar or diggings where the claim is located; and if such rules and regulations are not complied with by those holding claims within the district, the ground becomes open to occupation of the next comer.[123]

LXVI. Fully Developed Mine.

A mine composed of ore containing so little precious metal that it would not pay for the mere crushing of the rock after it was taken out might never be fully developed in the sense that the ore, such as it is, would be sufficiently exposed and ready for extraction to permit active operations in the regular course of mining to begin, and in such condition it might be said to be fully developed, and yet owing to the barrenness of the ore, it would be impossible to work it with profit.[124]

---

[120] Book vs. Justice Co., *supra* (95); Meydenbauer vs. Stevens, 78 Fed. 787; see, generally, Waterloo Co. vs. Doe, 56 Fed. 685; Burns vs. Clark, 133 Cal. 634; 66 Pac. 12; Burns vs. Schoenfield, 1 Cal. A. 121, 81 Pac. 713; Robertson vs. Smith, 1 Mont. 410; Sullivan vs. Schultz, 22 Mont. 541, 57 Pac. 279.

[121] Allen vs. Goodwin, 92 Tenn. 385, 21 S. W. 761. The word "foreman" is generally understood to mean a laborer, with power to superintend the labor of those working with him. Peterson vs. Whitebreast Co., 50 Iowa 673.

[122] Goldberg vs. Bruschi, *supra* (3); Florence-Rae Co. vs. Kimbel, 85 Wash. 162, 147 Pac. 881.

[123] St. John vs. Kidd, 26 Cal. 263. The state statutes are of no more force and effect than miner's rules and regulations. Stock vs. Plunkett, *supra*.(68) The failure of a party to comply with a mining rule or regulation can not work a forfeiture, unless the rule so provides. Emerson vs. McWhirter, 133 Cal. 510, 65 Pac. 1036, aff'd in 208 U. S. 30; see Stock vs. Plunkett *supra*. For manner of proving forfeiture see Goldberg vs. Bruschi, *supra* (3); for manner of proving abandonment, see Trevaskis vs. Peard, 111 Cal. 599, 44 Pac. 246. The mere intention to abandon, if not coupled with yielding up possession or a cessation of user, is not sufficient; nor will the non-user alone without an intention to abandon be held to amount to an abandonment. Abandonment is a question of fact to be determined by a jury or the court sitting as such. Utt vs. Frey, 106 Cal. 397, 39 Pac. 807; Wood vs. Ettiwanda Co., 147 Cal. 233, 81 Pac. 512.

[124] Peoples vs. Whalen, *supra*.(42)

LXVII. General Manager.

The term "general manager" imports general authority to perform all reasonable things in conducting the usual and customary business of his principal.[125]

LXVIII. Giant.

A "giant" is the nozzle of a pipe used to convey water for hydraulic mining and is used for the purpose of distributing or properly applying and increasing the force of the water.[126]

LXIX. Going Concern.

A "going concern" is one that continues to transact its ordinary business.[127]

LXX. Government Ownership.

The statutes asserting paramount title in the United States to mineral lands are in harmony with the laws of practice of other countries on the same subject.[128]

LXXI. Grizzlies.

"Grizzlies" are iron or steel bars used to sort or separate the rock or ore as it falls into the ore chutes.[129]

LXXII. Headers.

"Headers" are pieces of plank—longer than a cap—extending over more of the roof and supported by two props, one at each end.[130]

LXXIII. Held in Common.

The phrase "held in common" means a claim whereof there are more owners of a claim than one, while the use of the words "claims held in common" means that there must be more than one claim so held.[131]

LXXIV. High Grading.

The term "high grading" means the theft of ores.[132]

LXXV. Hydraulic Mining.

"Hydraulic mining" is the process by which a bank of gold-bearing earth and rock is excavated by a jet of water. discharged through the converging nozzle of a pipe under a great pressure, the earth or debris being carried away by the same water, through sluices, and discharged on lower levels into the natural streams and water courses below; where the gravel or other material of the bank is cemented, or where the bank is composed of masses of pipe-clay, it is shattered by blasting with powder.[133]

---

[125] Hinton vs. D'Yarmett, —— Tex. C. A. ——, 212 S. W. 518; Producers Co. vs. Mifflin Co., 82 W. Va. 311, 95 S. E. 950, see Carroll Cross Co. vs. Abrams Creek Co., 83 W. Va. 205, 98 S. E. 151. The president, secretary, or general manager of a mining corporation has no power, by reason of his office alone, to sell or lease the property of binding. Franklin vs. Havalena Co., 16 Ariz. 200, 141 Pac. 730; Simons vs. Inyo Co., 48 Cal. A. 524, 192 Pac. 144.

[126] Roseburg Bank vs. Camp, 89 Or. 67, 173 Pac. 316.

[127] White Co. vs. Pettes Co., 30 Fed. 865; Contra Costa Co. vs. Oakland, 159 Cal. 323, 113 Pac. 682.

[128] U. S. vs. San Pedro Co., 4 N. M. 294 17 Pac. 337. Under the common law of England mines of gold and silver were the exclusive property of the crown and did not pass under a grant by the king under the general designation of lands or mines. Hicks vs. Bell, 3 Cal. 219; Queen vs. Earl of Northumberland, 1 Plow. 310.

[129] Suborich vs. Alaska United Co., 251 Fed. 886.

[130] Big Branch Co. vs. Wrenchie, *supra*.(54)

[131] Chambers vs. Harrington, *supra*.(63)

[132] Atolia Co. vs. Industrial Accident Comm., 175 Cal. 691, 167 Pac. 148. See Goldfield Co. vs. Richardson, 194 Fed. 198; Daniels vs. Portland Co., 202 Fed. 637.

[133] Woodruff vs. North Bloomfield Co., 18 Fed. 753; see, also, U. S. vs. North Bloomfield Co., 53 Fed. 625; U. S. vs. Lawrence, 53 Fed. 633.

LXXVI. Improvement.

The word "improvement" means such an artificial change of the physical condition of the earth in, upon, or so reasonably near the mining claim as to evidence a desire to discover mineral therein or to facilitate its extraction, and in all cases the alteration must be permanent in character.[134]

LXXVII. Independent Contractor.

An "independent contractor" as applied in mining operations is one who exercises independent control over the mode and method by which he produces the results demanded by the contract.[135]

LXXVIII. Indian Title.

An Indian's right to occupancy of land, and that right recognized by the United States, constitutes "Indian title."[136]

LXXIX. Instrumentalities of Mining.

The true meaning of such expressions as "shafts," "tunnels," "levels," "uprises," "cross cuts," "inclines," "sump," etc., when applied to mines signifies instrumentalities whereby and through which such mines are opened, developed, prospected and worked.[137]

LXXX. Lands Valuable for Minerals.

The term "lands valuable for minerals" as used in the mining law applies to all lands chiefly valuable for nonmetalliferous deposits, such as alum, asphaltum, borax, guano, diamonds, gypsum, marble, mica, slate, amber, petroleum, limestone, and building stone, rather than for agricultural purposes.[138] Such lands are subject to disposition by the United States under the mining laws only.[139]

---

[134] Fredericks vs. Klauser, 52 Or. 110, 96 Pac. 679. See Sheldon, 43 L. D. 156. The term "improvements" used in a contract of sale of a mine means such things as are placed thereon by way of betterment and which are of a permanent nature and which add to the value of the property as real property and aid in the extraction of mineral profitably and successfully. Seigloch vs. Bisbee, 106 Wash. 632, 181 Pac. 53. See Lewin vs. Telluride Co., 272 Fed. 597. There is a broad and distinctive difference as applied to the mining laws between the word "discovery" and the words "expenditures," "improvements" or "development," and the three latter are not synonymous with the first. Union Oil Co., 23 L. D. 223; see St. Louis Co. vs. Kemp, 104 U. S. 636; Jackson vs. Roby, 109 U. S. 440; Chambers vs. Harrington, *supra* (60); Good Return Co., 4 L. D. 221.

[135] Wooton vs. Dragon Co., 54 Utah 459, 181 Pac. 597. See, generally, Alabama Co. vs. Smith, 203 Ala. 70, 82 So. 31; Coal Corp. vs. Davis, 17 Ala. 22, 81 So. 359.

[136] Van Moore, 221 Fed. 9954. This right of occupancy has always been held sacred, something not to be taken from him, except by his consent, and then only upon such considerations as should be agreed upon. Minn. vs. Hitchcock, 185 U. S. 389; Hallowell vs. U. S., 221 U. S. 317. See Nadeau vs. U. P. R. Co., 253 U. S. 442. Cramer vs. U. S., 262 U. S. 219; Sperry Oil Co. vs. Chisholm, 264 U. S. 488. See opinion, 50 L. D. 315.

[137] Hines vs. Miller, 122 Cal. 688, 55 Pac. 401. Woodward Co. vs. Jones, 80 Ala. 123. For "surface instrumentalities", see Cavanaugh vs Corbin Co., 55 Mont. 173, 174 Pac. 185.

[138] Webb vs. American Co., 157 Fed. 205; see N. P. R. Co. vs. Soderberg, *supra* (72); Pacific Coast Co. vs. N. P. R. Co., *supra*.(90)

[139] Deffebach vs. Hawke, *supra* (72); Davis vs. Weibbold, *supra*.(23) Lands known to be valuable for mineral can not be acquired for any purpose other than for mining and under the mining statute, and the term "lands known to be valuable for mineral" means that there must be knowledge of the presence of mineral deposits of such quality and in such quantity as would render their extraction profitable and justify expenditures to that end; but there are vast tracts of public land in which minerals of different kinds are found, but not in such quantity as to justify expenditures in the effort to extract them, and it is not as to such lands that the term "mineral" in the sense of the statute applies. The term "known to be valuable" has reference to the time of purchase, and if land so purchased is not so known to be valuable at the time doubt can not be cast upon the title by any subsequent discovery of minerals, however valuable. Diamond Coal Co. vs. U. S., 233 U. S. 240. See Meyers vs. Pratt, 255 Fed. 765.

LXXXI. Lapsed.

The word "lapsed" is unknown to mining usage or laws and is not equivalent to the term "forfeited" nor does it mean a technical forfeiture.[140]

LXXXII. Lead.

The word "lead" applied to mines may have a more extensive meaning than the word "lode" or "ledge".[141]

LXXXIII. Lease by Federal Government.

In its control and disposition of its public mineral lands, the United States acts in its proprietary capacity, and not in virtue of any attribute of sovereignty. As paramount proprietor, it has the same right of control and disposition as is incident to absolute ownership in an individual.[142]

LXXXIV. Located.

The word "located" means delimited by having the boundaries ascertained and monumented on the ground, identified by having a notice of location posted upon the land, and further proclaimed to the public by having such notice of location recorded in the manner customary under the rules for recording mining claims. It has long been recognized, particularly in California, commencing with Miller vs. Chrisman, *supra* (58); see, also, Weed vs. Snook, 144 Cal. 439, 77 Pac. 1023; Merced Co. vs. Patterson, 153 Cal. 625, 96 Pac. 90, McLemore vs. Express Co., *supra*,(37) that a claim so located, whether discovery shall have been made or not, is property and the subject of conveyance and the passing of rights therein from one to another.[143]

LXXXV. Location.

A "location" is the act of taking or appropriating a parcel of mineral land.[144] It includes the posting of notices, the record thereof when required, and marking the boundaries [145] so that they can be readily traced.[146] The terms "location" and "mining claim" are synonymous, although a "mining claim" may consist of several "locations."[147]

---

[140] Contreras vs. Merck, 131 Cal. 211, 63 Pac. 336, but see U. S. vs. California Midway Oil Co., *supra* (49); Thornton vs. Phelan, *supra*.(7)

[141] Inimitable Co. vs. Union Co., 1 Cal. Unrep. 599. The term "lode" is an alteration of the verb "lead." Eureka Co. vs. Richmond Co., 8 Fed. Cas. 819, whatever a miner would follow with the expectation of finding ore has been adopted and may be regarded as a practical test of what is considered a lode. Henderson vs. Fulton, 35 L. D. 661; King Solomon Co. vs. Mary Verner Co., 22 Còlo. A. 528, 127 Pac. 129; Ambergris Co. vs. Day, 12 Ida. 115, 85 Pac. 109; see Eureka Co. vs. Richmond Co., 103 U. S. 839. Any body of mineralized rock is a lode. Book vs. Justice Co., *supra* (15); Shoshone Co. vs. Rutter, 87 Fed. 801.

[142] Mid-Northern Oil Co. vs. Walker, 65 Mont. 414, 211 Pac. 353.

[143] Union Oil Co. vs. Smith, *supra*.(3) *Compare* Cole vs Ralph, *supra* (7); U. S. vs. Sherman, 288 Fed. 498.

[144] St. Louis Co. vs. Kemp, *supra*,(134) Cole vs. Ralph, *supra* (7); see, also Creede Co. vs. Unita Co., *supra*.(106)

A valid and subsisting location of mineral lands made and kept up in accordance with the provisions of the statutes of the United States, has the effect of a grant by the United States of the right of present and exclusive possession of the lands located. Gwillim vs. Donnellan, 115 U. S. 49; Manuel vs. Wulff, *supra* (61); *compare* White Star Co. vs. Hultberg, 220 Ill. 578, 77 N. E. 327. See Butte City S. H. L. Cases 6 Mont. 397, 12 Pac. 858.

[145] Smith vs. Union Oil Co., 166 Cal. 217, 135 Pac. 966, aff'd in 249 U. S. 337; Sharkey vs. Candiani, 48 Or. 112, 85 Pac. 219.

[146] Cole vs. Ralph, *supra* (7); Erwin vs. Perego, 93 Fed. 611; Walton vs. Wild Goose Co., 123 Fed. 209.

[147] Del Monte Co. vs. Last Chance Co., 171 U. S. 74.

LXXXVI. Location and Patent.

The "location" of a mining claim and a "patent" for a mining claim are not governed by the same rules. The mining statutes expressly provide for the location of surface ground that must include the lode or claim as discovered; and a patent can not grant any greater extent of surface ground than the location as made and marked by the surface boundaries.[148]

LXXXVII. Location and Record.

A "location and its record" are different things. The federal and state statutes distinguish between them, the former even in authorizing local rules "governing the location and manner of recording." The statutory object is to protect and reward discoverers of mines. Discovery with intent to claim is the principal thing and vest an estate—an immediate fixed right of present and exclusive enjoyment in the discoverer. The record is incidental machinery to secure to the discoverer his reward and to give notice to others. The spirit of all recordation acts is notice to protect others against secret equities. If the record is not necessary to create the estate (as it is in the matter of homestead exemptions and mechanic's liens), the statute providing for recording is but a direction to do certain acts and does not create conditions subsequent; and if the statute provides no forfeiture for failure to record, by failure the estate is not divested.[149]

LXXXVIII. Lode Location.

Among practical miners the terms "lode," "lode location" and "mining claim" are used interchangeably.[150]

LXXXIX. Maps.

A "map" is a drawing upon a plane surface representing a part of the earth's surface, and the relative position of objects thereon. It may also be so drawn as to show the geological structure and other physical facts necessary to a complete understanding of the matter at issue.[151]

---

[148] Whilden vs. Maryland Co., *supra*.(119); see Silver King Co. vs. Conkling Co., *supra*.(95) The only distinction between a patentee of a mining claim and a mineral locator is in the ownership of the fee. Forbes vs. Gracey, *supra* (21); Duggan vs. Davey, *supra*.(95) The placer mining laws, which originally provided for the patenting of a fee estate in both the surface and the mineral deposits of public lands have been modified by various acts of congress to permit of the issuance of separate patents for the reserved mineral deposits under the mining laws. See Report XX of the State Mineralogist, July, 1924, "Oil and Gas Rights" Part IV, page 212.

[149] Clark-Montana Co. vs. Butte & S. Co., 233 Fed. 547; see Stock vs. Plunkett, *supra*.(68)

[150] Buckeye Co. vs. Carlson, 16 Colo. A. 446, 66 Pac. 168.

[151] Montana Co. vs. Boston Co., 27 Mont. 288, 70 Pac. 1114. A map in itself proves nothing, unless it is shown by competent evidence to be a correct representation of the relative position of the objects it purports to delineate. Daggett vs. Yreka Co., 149 Cal. 357, 86 Pac. 988; Duncan vs. Eagle Rock Co., 48 Colo. 569, 111 Pac. 588. A copy of a map certified by the register of and on file in the land office is admissible in evidence. Goodwin vs. McCabe, 75 Cal. 584, 17 Pac. 705; see Patrick vs. Nance, 26 Tex. 298.

A map made by a surveyor showing a description and location of a mining claim in controversy is sufficiently supported where the surveyor testifies that he found fixed monuments on certain corners and on one side line of the claim and that in surveying he considered both the data on the ground as well as that given in the notice of location. Batt vs. Steadman, 36 Cal. A. 608, 173 Pac. 99.

In case of an unpatented mining claim, a map purporting to show the lines of the location is of no probative value unless supported by the evidence of some one who knows the position of the monuments which defined those lines; for it is by the location monuments alone that their beginning and direction can be determined. Miller vs. Grunsky, 141 Cal. 441, 66 Pac. 858; Daggett vs. Yreka Co., *supra*, see Blake vs. Doherty, 5 Wheat. 359; U. S. vs. Montana Co. 196 U. S. 573; Duncan vs. Eagle Rock Co., *supra*. But a map based upon a fabricated public survey may be referred to in aid of the description of a mining claim. Gird vs. California Oil Co., *supra*.[illegible]

When a witness refers to a map, he should be required to designate thereon, or by language to what reference is made, and in such manner that the whole testimony can be considered from the record. Oberstock vs. United Co., 68 Or. 197, 137 Pac. 195.

XC. Markings.

Stakes, posts, piles of stone, boulders, blazing trees along the boundaries of the claim or at the corners thereof, cutting away undergrowth, making a trail through the timber along the sides or ends of the claim, putting up a stake at the point of discovery, blazing stumps, posting a notice at the point of discovery, posting a notice upon the ground, placing such notice in a tin can and attaching it to a stake, fastening such notice to a tree or placing it in a box, are all "markings."[152]

XCI. Master and Servant.

One who represents and carries out the will of the master or of a mine operator in the prosecution of the work not only as to the result to be accomplished but also as to the means to be employed, is a servant and not an independent contractor.[153]

XCII. Meander Line.

A "meander line" is a line run in a survey of a mining claim bordering upon a stream or other body of water, not as a boundary of the tract surveyed, but for the purpose of defining the sinuosities of the bank or shore of the water, and as a means of ascertaining the quantity of land within the surveyed area.[154]

XCIII. Metallic.

The term "metallic" is used to indicate the condition of a metal in which it exists by itself, and is not mineralized nor combined with those substances which take away its metallic character and convert it into an ore.[155]

XCIV. Metallic Ore.

From a strictly scientific point of view, the terms "metallic ore" and "ore deposits" have no clear significance. They are purely conventional expressions, used to describe those metalliferous minerals or bodies of mineral having economic value, from which the useful metals can be advantageously extracted. In one sense rock salt is ore of sodium, and limestone an ore of calcium, but to term beds of those substances "ore deposits" would be quite outside of current usage.[156]

XCV. Metalliferous.

The term "metalliferous" is not one admitting of precise definition. It means yielding or producing metals; as a metalliferous ore of deposit; a metalliferous district. But the metals and nonmetals are not subject, chemically or scientifically, to a conclusive definition or classification.[157]

---

[152] Meydenbauer vs. Stevens, *supra* (120); Ledoux vs. Forester, 94 Fed. 602; Walsh vs. Erwin, 115 Fed. 532; Oregon King Co. vs. Brown, 119 Fed. 51, 52; Holdt vs. Hazard, *supra* (16); Madeira vs. Sonoma Co., 20 Cal. A. 719, 130 Pac. 175; Allan vs. Dunlap, 24 Or. 236, 33 Pac. 675; see Book vs. Justice Co., *supra* (15); Tiggerman vs. Mrzlak, 40 Mont. 23, 105 Pac. 77. Posted notices may constitute a part of the marking and may aid in determining the situs of the monuments marking the claim, and they constitute a part of the marking, and while on account of the temporary nature may be of minor significance, yet this is not so where the location is followed by the actual and continued working of the claim. Eaton vs. Norris, 131 Cal. 565, 63 Pac. 826; see Jupiter Co. vs. Bodie Con. Co., 11 Fed. 666.

[153] Clinton Co. vs. Bradford, 200 Ala. 308, 76 So. 79. The term "workman" or "workingman" means one whose time is at the disposal of his employer. Peo vs. Alvarez, 28 Porto Rico 890.

[154] Alaska United Co. vs. Cincinnati Alaska Co., 45 L. D. 340. See Savard, 50 L. D. 381.

[155] Hempstead & Son vs. Thomas, 122 Fed. 540.

[156] Con. Ores Co., *supra*. (55)

[157] Con. Ores Co., *supra* (55); see Montague vs. Dobbs, 9 C. L. O. 165; Overman Co. vs. Corcoran, 15 Nev. 152.

XCVI. Mine.

A "mine" is variously defined; an opening or excavation in the earth for the purpose of extracting minerals; a pit or excavation in the earth from which metallic ores or other mineral substances are taken by digging; an opening in the earth made for the purpose of taking out minerals, and in case of coal mines, commonly a worked vein; an excavation properly underground for digging out some usual product, as ore, metal, or coal, including any deposit of any material suitable for excavation and working as a placer mine; the underground passage and workings by which the minerals are gotten together with these minerals themselves.[158]

A "mine" is a work for the excavation of minerals by means of pits, shafts, levels, tunnels, etc., as opposed to a "quarry," where the whole excavation is open.[159] In general the existence of a mine is determined by the mode in which the mineral is obtained, and not by its chemical or geological character.[160]

The term "mine" also is defined as including only mines valuable for their minerals or valuable mineral deposits.[161]

The term "mine" as used in the Mining Act appears to be synonmous with the term "vein or lode."[162] It also is used as synonymous with the term "mining claims."[163]

There is a lack of unanimity in the decisions of the courts as to the status of an oil well. In some instances it is held to be a mine; and in other cases that it is not a mine.[164]

XCVII. Miner.

A "miner" is one who mines, a digger for metals and other minerals. He is not necessarily a mechanic, handcraftsman or artisan, and the term imports neither learning nor skill.[165]

---

[158] N. P. R. Co. vs. Mjelde, 48 Mont. 287; 137 Pac. 386.

[159] Murray vs. Allred, 100 Tenn. 100, 43 S. W. 355, see People vs. Bell, 237 Ill. 332, 86 N. E. 593; Escott vs. Crescent Co., 56 Or. 192, 106 Pac. 452; see, also, Darvill vs. Roper, 3 Drewry 294; see Jacobs Law Dict.

[160] Johnson vs. California Lustral Co., 127 Cal. 283, 59 Pac. 595; see, also, Rex vs. Dunsford, 2 Adol. & Ell., 568.

[161] Davis vs. Weibbold, *supra* (139); Dower vs. Richards, 151 U. S. 658; Barden vs. N. P. R. Co., 154 U. S. 288; Callahan vs. James, 141 Cal. 291, 74 Pac. 853; Nephi Co. vs. Juab Co., 33 Utah 114, 93 Pac. 53. "Mines" as the term is known to the mineral laws of the United States, "embrace nothing but deposits of valuable mineral ores, and do not include mere masses of nonmineralized rock, whether rock in place or scattered through the soil." Wheeler vs. Smith, 5 Wash. 704.

[162] Bullion-Beck Co. vs. Eureka Hill Co., 5 Utah 3, 103 Pac. 881. An unpatented location is a "mine" within the purview of the mining act. A mine upon a patented homestead is not less a mine because the title from the government was acquired under the laws providing for the disposition of agricultural lands only. An undeveloped body of ore is not a "mine" though the title to it was secured under the mineral laws, but it is merely a part of the real estate itself. NPR. Co. vs. Mjelde, *supra*.(158)

[163] Idaho Co. vs. Davis, 123 Fed. 396; Hamilton vs. Delhi Co., 118 Cal. 148, 50 Pac. 378; Phillips vs. Salmon River Co., 9 Ida. 149, 72 Pac. 886.

The word "mine" as used in the mining law, may be used to designate "the whole claim or body of mining ground." Smith vs. Sherman Co., 12 Mont. 524, 31 Pac. 72; Tredinnick vs. Red Cloud Co., 72 Cal. 78, 12 Pac. 152, but see Shaw vs. Wallace, 25 N. J. L. 461.

[164] Berentz vs. Belmont Oil Co., 148 Cal. 577, 84 Pac. 47; Mid-Northern Co. vs. Walker, *supra* (242); see Burke vs. S. P. R. Co., 234 U. S. 967; *compare* Hollingsworth vs. Berry, 107 Kan. 544, 192 Pac. 763; Kreps vs. Brady, 37 Okla. 754, 133 Pac. 216; Carter vs. Phillips, 88 Okla. 202, 212 Pac. 747; J. M. Guffey Co. vs. Murrel, 127 La. 483, 53 So. 705.

[165] Watson vs. Lederer, 11 Colo. 577, 19 Pac. 602. A laborer at an oil well is not a miner. J. M. Guffey Co. vs. Murrel, *supra*.(164)

XCVIII. Mineral.

In its broadest and scientific meaning, a "mineral" is any inorganic species having a definite chemical composition.[166] In its commercial sense the term "mineral" has been defined as any organic substance found in nature having sufficient value separate from its situs as part of the earth to be mined, quarried, or dug for its own sake or its own specific use.[167] When used in grants or in reservations or instruments of conveyance the term "mineral" is not limited to metals nor metalliferous deposits, whether contained in veins that have well-defined walls or in beds or deposits that are irregular and are found at or near the surface or otherwise.[168]

XCIX. Mineral Interests.

"Mineral interests" in land means all the minerals beneath the surface. Such interests are a part of the realty and the estate in them is subject to the ordinary rules of law governing the title to real property.[169]

C. Mineral Lands.

The term "mineral lands" includes land which is worth more for mining than for agriculture. The fact that the land contains some gold or silver would not constitute it "mineral land" if the gold and silver did not exist in sufficient quantities to pay to work.[170] Land not mineral in character is subject to entry and patent as a homestead however limited its value for agricultural purposes.[171]

CI. Mineral Right.

A "mineral right" imports a title or right to all that is mineral in the land.[172]

CII. Minerals Crude.

"Minerals crude" is a term used in the classification of ores under the tariff act of 1897 and embraces "minerals, crude or not advanced in value or condition by refining or grinding, or by other processes not especially provided for in the act; or metallic mineral substances in a crude state and metals unwrought, not specifically provided for in this act."[173]

---

[166] See Glasgow vs. Farie, L. R. 13 A. C. 657. The term "mineral" should not be confined to metals or metallic ores. All metals are minerals, but all minerals are not metals. N. P. R. Co. vs. Soderberg, *supra.*(72)

[167] Rock House Co. vs. Raleigh Co., 83 W. Va. 20, 97 S. E. 684.

[168] It can not be said that the term "minerals" includes only such substances as are procured by tunnelling and shafting, as much gold is procured by placer mining, and rich deposits of manganese and other like ores are found upon the surface of the earth and sometimes are obtained without either quarrying or mining. Byron vs. Utah Co., 53 Utah 151, 178 Pac. 53; see Glasgow vs. Farie, *supra.*(166) The word "mineral" includes petroleum rights. Lovelace vs. Southwestern Co., 267 Fed. 504, 514. See Burke vs. S. P. R. Co., *supra.*(164) Mineralized matter is crushed and loose rock material containing minerals irregularly deposited, from solution. It may be in beds, or in fissures. Eureka Co. vs. Richmond Co., Fed. Cas. 4548; Doe vs. Waterloo Co., 54 Fed. 943.

[169] Hoilman vs. Johnson, 164 N. Car. 268, 80 S. E. 249; see, also, Riggs vs. Board, 181 Ind. 172, 103 N. E. 1077. Mining rights and interests in minerals are the subject of horizontal severance from the surface and taxable as real estate. Riggs vs. Board, *supra.*

[170] Deffeback vs. Hawke, *supra.*(52) In Davis vs. Wiebold, *supra,*(139) the whole question of mineral lands is fully discussed. U. S. vs. N. P. R. Co., 1 Fed. (2nd) 57.

[171] See U. S. vs. Kostlak, 207 Fed. 450. Peoples Dev. Co. vs. S. P. Co., 277 Fed. 794. See, also, U. S. vs. S. P. R. Co., 251 U. S. 1, citing Benjamin vs. S. P. R. Co., 21 L. D. 390.

[172] McGraw vs. Lakin, 67 W. Va. 385, 68 S. E. 27.

[173] Hempstead & Son vs. Thomas, *supra* (155); see U. S. vs. Graser-Rothe Co., 164 Fed. 205; U. S. vs. Brewster, 167 Fed. 122; Myers vs. U. S., 178 Fed. 468; Con. Ores Co., supra.(55). See, also, Carothers vs. Mills, —— Tex. ——, 233 S.W. 155.

CIII. Mineral Surveyor.

A "mineral surveyor" is an officer or employee of the general land office within the scope of section 452 of the Revised Statutes of the United States.[174]

CIV. Miners' Devices.

Miners use various devices to protect the posted notice from destruction by the elements, such as covering it with glass, or folding it in a box and placing the box in a conspicuous place, or putting the notice upon a mound of rocks, folding it and partially covering it with a rock [175] or putting the notice in a tin can.[176] A substantial compliance with the law is sufficient.[177]

CV. Miners' Inch.

The term "miners' inch" is not definite without specification of the head or pressure.[177a] It has no fixed meaning and in one locality sometimes is a very different quantity according to "miner's measurement" in another locality.[177b] It has been defined as "the amount of water that will pass in twenty-four hours through an opening one inch square under a pressure of six inches." [178]

In California "the standard miner's inch of water shall be equivalent or equal to one and one-half cubic feet of water per minute, measured through any aperture or orifice." Stats. 1901, p. 660.

CVI. Miner's Lien.

A "miner's lien" is a creature of statute to which the miner must look for the right and authority to file any such lien.[179]

CVII. Miner's Weight.

The term "miner's weight" used in a coal mining lease as the basis for the price per ton to be paid for mining, is not a fixed, unvarying quantity of mine-run material, but is such a quantity of material as operators and miners may, from time to time, agree as being necessary or sufficient to produce a ton of prepared coal.[180]

---

[174] U. S. vs. Havenor, 209 Fed. 989. The matter of employment and the manner and amount of payment of a mineral surveyor are left wholly to the option of the mineral claimant and such officer. Fish & Hunter Co. vs. New England Homestead Co., 28 S. Dak. 590.

[175] Donahue vs. Meister, 88 Cal. 121, 25 Pac. 1096. It can not be said as a matter of law that a notice of location of a mining claim is insufficient where the notice was written on a piece of white paper and placed on a stick leaning up against a side cut upon the surface rock, and another rock being put on top of the paper so that it would not blow away, the paper being large enough to show under the rock, but the writing itself was not exposed. Emerson vs. Akin, 26 Colo. A. 40, 140 Pac. 482. In Hagan vs. Dutton, (20 Ariz. 476, 181 Pac. 581) the posting of the notice of location between the rocks of one of the location monuments of stone, although hidden from view by dirt and gravel, was held sufficient.

[176] Gird vs. California Oil Co., *supra*.(82)

[177] Donahue vs. Meister, *supra*.(175)

[177a] Longmire vs. Smith, 26 Wash. 439, 67 Pac. 246.

[177b] Dougherty vs. Haggin, 56 Cal. 522; see Gardner vs. Wright, 49 Or. 609, 91 Pac. 286. An "inch" is estimated on the basis of forty inches to one second foot. Hough vs. Porter, 51 Or. 318, 98 Pac. 1083. "Head of water" is the quantity entering the intake of any canal or ditch. Ulrich vs. Pateros Co., 67 Wash. 328, 121 Pac. 818.

[178] 27 Cyc. 515; see Longmire vs. Smith, *supra*.(177a) For an interesting case see Lillis vs. Clear Creek Co., 32 Cal. A. 668, 163 Pac. 1041. See, also, Morrison's Mining Rights, (15th ed.), 702.

In cases of ambiguity oral evidence may explain what is meant by the use of the term "miners' inch." Ulrich vs. Pateros, *supra*.(177a) See Logan vs. Guichard, 159 Cal. 592, 114 Pac. 989; Gardner vs. Wright, *supra*.(177b)

[179] Bishop vs. Henry, 84 Or. 389, 165 Pac. 239.

[180] Drake vs. Berry, 259 Pa. St. 8, 102 Atl. 320; see, also, Drake vs. Lacoc, 157 Pa. St. 17, 27 Atl. 538. For a case involving specific gravity and cubic feet requisite to make a ton of ore; see Silver King Co. vs. Conkling Co., 255 Fed. 744.

CVIII. Mining.

The word "mining" includes placer mines in which the workings are open, and hence the question whether an enterprise is mining or not can not be determined by an inquiry as to whether the workings are open or underground.[181]

CIX. Mining and Milling.

"Mining and milling" would seem to be, taken together, one industry, having for its object "to obtain possession of material products in the state in which they were fashioned by nature." Mining the process of extracting from the earth the rough ore, would seem to be the first step in the process, milling or reducing the second step, to wit: the further separating of the materials found together, the one from the other, and extracting from the mass the particular product desired.[182]

CX. Mining Claim.

As the term "mining claim" is used in the mining act, a "mining claim" is that portion of a vein or lode and of the adjoining surface, or of the surface and subjacent material to which a claimant has acquired the right of possession by virtue of a compliance with such statute and the local laws and rules of the district within which the location may be situated.[183] Independent of acts of Congress providing a mode for the acquisition of title to the mineral lands of the United States, the term "mining claim" has always been applied to a portion of such lands to which the right of exclusive possession and enjoyment by a private person or persons, has been asserted by actual occupation, or by a compliance with the local mining laws, or district rules.[184]

2. Distinction between Mining Claim and Location. The terms "mining claim" and "location" are not always synonymous and may often mean different things, as a mining claim may refer to a parcel of land containing precious metal in its soil or rock, while location is the act of appropriating such land according to certain established rules.[185] A "mining claim" may include as many adjoining locations as the locator may make or purchase, and the ground covered by all, though constituting what he claims for mining purposes will constitute a "mining claim" and will be so designated.[186]

CXI. Mining District.

A "mining district" is a section of country usually designated by name, having described or understood boundaries within which mineral is found and which is worked under rules and regulations prescribed by the miners therein.[187] There is no limit to its territorial extent [188] and its boundaries may be changed if vested rights are not thereby interfered with.[189]

---

[181] Burdick vs. Dillon, 144 Fed. 741. One engaged in the construction of shafts, tunnels, and the like, for prospecting and developing a mine, is engaged in mining as much as he who extracts ore or gravel from the mine. Johnson vs. California Lustral Co., *supra.*(160) The process of mining is a "business." Stratton's Independence vs. Howbert, 231 U. S. 399; Sutter Co. vs. Nichols, 152 Cal. 688, 93 Pac. 872. But the business of mining is not a public utility in the absence of a local constitutional provision. See Con. Channel Co., 51 Cal. 269; Amador Queen Co. vs. DeWitt, 73 Cal. 482, 15 Pac. 74. See, generally, Clark vs. Nash, 198 U. S. 361; Strickley vs. Highland Boy Co., 200 U. S. 527; Goldfield Con. Co. vs. Old Sandstorm Co., 38 Nev. 426, 150 Pac. 313; Highland Boy Co. vs. Strickley, 28 Utah 215, 78 Pac. 296.

[182] Rollins, 102 Fed. 985.

[183] Trinity Co. vs. Beaudry, 223 Fed. 741; Morse vs. DeArdo, 107 Cal. 622, 40 Pac. 1018.

[184] Mt. Diablo Co. vs. Callison, 17 Fed. Cas. 9886; Argonaut Co. vs. Kennedy Co., 84 Fed. 2; Escott vs. Crescent Co., *supra.* (159)

[185] St. Louis Co. vs. Kemp (134); Peabody Co. vs. Gold Hill Co., 97 Fed. 661; McFeters vs. Pierson, 15 Colo. 203, 24 Pac. 1076. The words "claim" and "location" are used interchangeably. Del Monte Co. vs. Last Chance Co., *supra.*(147)

[186] St. Louis Co. vs. Kemp, *supra* (134); Carson City Co. vs. North Star Co., 83 Fed. 664; see U. S. vs. Brookshire Oil Co., *supra* (82); Con. Mutual Oil Co. vs. U. S., *supra.*(49)

2. Persons. No certain number of persons are necessary to effect its organization.[190]

3. Corporations. A corporation may take part in the formation of a mining district.[191]

4. Regularity of Proceedings. The regularity of the mode in which the district was organized will not be inquired into by the courts unless some fraud be shown.[192]

5. Officers of District. The officers of a district are usually limited to a "Mining Recorder," who is elected by the miners thereof and therein, for a specified term.

6. Duties of Recorder. He should keep proper books for recording instruments therein.[193] Errors of recordation are not necessarily fatal.[194]

7. Organization. The organization of mining districts is entirely optional with the miners, as there is no law requiring such organization.[195]

CXII. Mining Ground and Mining Land.

No land can be a "mining claim" unless based upon a location; otherwise it may be "mining ground" or a "mine." [196] For instance, the bed of a navigable river is not subject to mining location, but if mining is conducted thereon by dredging, it is mining ground; [197] or, where land is covered by an agricultural patent and worked for its mineral deposits, it is "mining ground" and not a "mining claim." [198] Hence, land from which a mineral substance is obtained from the earth by the process of mining may, with propriety, be called "mining ground" or "mining land" [199] although the terms "valuable for minerals" and "valuable for mineral deposits" are not equivalent to the term "mining ground." [200]

CXIII. Mining Purposes.

The phrase "mining purposes" as used in connection with mill-site locations, is very comprehensive, and may include any reasonable use for mining purposes which the quartz lode mining claim may require for its proper working and development. This may be very little, or it may be a great deal. The location of a quartz lode mining claim is required to do only one hundred dollars worth of work each year until he obtains a patent therefor. But if he does only this amount, and uses the mill-site in connection therewith, is not this the use of a mill-site for mining purposes in connection with the mine? Who shall prescribe what shall be the kind and extent of the use under the statute so long as it is used in good faith in connection with the mining claim for a mining purpose.[201]

---

[187] U. S. vs. Smith, 11 Fed. 487; see Campbell vs. Rankin, 99 U. S. 261.

[188] King vs. Edwards, 1 Mont. 235.

[189] Id.

[190] But see Fuller vs. Harris, 29 Fed. 814.

[191] McKinley vs. Wheeler, *supra.*(62)

[192] Gore vs. McBrayer, 18 Cal. 583.

[193] Fuller vs. Harris, *supra* (4); McCann vs. McMillan, 129 Cal. 350, 62 Pac. 31.

[194] Myers vs. Spooner, 55 Cal. 257; Weese vs. Barker, 7 Colo. 178, 2 Pac. 219.

[195] Rose Claim, 22 L. D. 83.

[196] Forbes vs. Gracey, *supra* (21); Williams vs. Santa Clara Ass'n., 66 Cal. 193, 5 Pac. 85; Bewick vs. Muir, 83 Cal. 368, 23 Pac. 389; Morse vs. De Ardo, *supra* (183); Ball vs. Tolman, 119 Cal. 358, 51 Pac. 546.

[197] Ball vs. Tolman, *supra.*(196)

[198] Morse vs. De Ardo, *supra.*(196)

[199] People vs. Bell, *supra.*(159) Oil is a mineral substance obtained from the earth by a process of mining, and lands from which it is procured may with propriety be called mining lands. Burke vs. S. P. R. Co., 234 U. S. 907; Gill vs. Weston, 110 Pa. St. 417.

[200] Johnson vs. California Lustral Co., *supra.*(160)

CXIV. Mining Right.

A "mining right" upon a specific piece of ground is a right to enter upon and occupy the ground for the purpose of working it, either by underground excavations or open workings, to obtain from it the mineral ores which may be deposited therein.

By implication the grant of such right carries with it whatever is incident to it, and necessary to its beneficial enjoyment.[202]

2. Distinction between Conveyance of Mineral and Grant of Mining Right. There is a clear distinction between an absolute conveyance of minerals in place and the grant of a "mining right" to another upon certain described land to convert the mineral into personalty and dispose of it. In the former case there is a severance of the title to the realty; in the latter, there is not, although the "mining right" entitles the grantee to extract every particle of the mineral, but the grant is not of the mineral in place, but only of the mineral rights and privileges.[203]

3. Species of Trade. The working of a mine under a bare "mining right" uniformly has been considered by courts of equity as a species of trade.[204] The legal relation existing between two or more persons interested in such a right is that of a qualified partnership and the remedies relating to a mining partnership are available for the assertion or violation of any right arising out of it.[205]

4. Partition. It has been decided in California that a mere "mining right" is not an estate which can be made the subject of a partition.[206]

CXV. Mining Title.

The term "mining title" as employed in Revised Statutes (§ 910) means the title which the miner obtains by his discovery and location, followed by a compliance with the statutory regulations to preserve the right of possession, and in possessory actions between persons the case shall be adjudged by the law of possession, though the paramount title is in the United States.[207]

In a possessory action contemplated by the above section no greater proof of a right to recover can be required in a state court than would be required in a court of the United States, unless made so by a statute of the state.[208]

---

[201] Hartman vs. Smith, 7 Mont. 28, 14 Pac. 648; see, also, S. P. Mines vs. Valcalda, 79 Fed. 890; Valcalda vs. S. P. Mines, 86 Fed. 93.

[202] Smith vs. Cooley, 65 Cal. 46, 2 Pac. 880; People vs. Bell, *supra* (199); see Last Chance Co. vs. Bunker Hill Co., 131 Fed. 579; Armstrong vs. Maryland Co., 67 W. Va. 589; 69 S. E. 195; see Carothers vs. Mills, *supra*,(173).

In every private grant there passes by implication that which is reasonably necessary to the enjoyment of the thing granted. Washburn on Easements, (4th ed.) 49, 54. Hence a grant of the minerals under the surface of the land implies a right to mine them by the sinking of shafts or boring of tunnels and the removal of them through such openings. Himrod vs. Ft. Pitts Co., 220 Fed. 82.

[203] Chandler vs. French, 73 W. Va. 658, 81 S. E. 825; see McGraw vs. Lakin, 67 W. Va. 385, 68 S. E. 27.

[204] Smith vs. Cooley, *supra*.(202)

[205] Id.

[206] Id. See, also, Musick Co. vs. Chandler, 158 Cal. 13, 109 Pac. 613.

[207] Gillis vs. Downey, 85 Fed. 486; see, also, Belk vs. Meagher, 104 U. S. 284; Del Monte Co. vs. Last Chance Co., *supra* (184); Price vs. McIntosh, 1 Alaska 292.

[208] Harris vs. Kellogg, 117 Cal. 499, 49 Pac. 708; see Haws vs. Victoria Copper Co., 160 U. S. 317.

CXVI. Models.

A "model" is a *facsimile* in three dimensions—a reproduction in miniature of the underground workings of a mine, showing the shafts, tunnels, drifts, crosscuts, etc., in all their details. From its very nature, it does not fall within any definition of the word "map" and it is a misapplication of the term to call it a map, though it may far better serve the purpose in hand.[209]

CXVII. Monuments.

"Monuments" are permanent landmarks established for the purpose of indicating boundaries.[210]

CXVIII. Mucker.

A "mucker" is a miner whose duty it is to load ore in the heading on cars after the ore has been extracted by the miners.[211]

CXIX. Name of Lode.

The "name of the lode" is that by which it is designated in the notice of location,[212] and subsequent addition thereto is immaterial.[213] The same vein or lode may have different names in different mining locations.[214]

CXX. Negligence.

"Negligence" in a legal sense is a failure upon the part of a mine operator to observe for the protection of the interests of the miner that degree of care, precaution, and vigilance which the circumstances justify demand, whereby the miner suffers injury.[215]

CXXI. Not Previously Known to Exist.

The words "not previously known to exist" refer to the time of the location and commencement of the tunnel and not to the respective times of the discoveries of the various veins in the tunnel.[216]

CXXII. Obliterated Corner.

An "obliterated corner" is one where no visible evidence remains of the work of the original surveyor.[217]

---

[209] Montana Co vs. Boston Co., *supra.*(151) The practice of admitting maps, models and photographs in evidence in all proper cases should be encouraged. Such evidence usually clarifies some issue, and gives the jury and court a clearer comprehension of the physical facts than can be obtained from the testimony of witnesses. Kelly vs. City, 83 Wash. 55, 145 Pac. 57.

[210] Thompson vs. Hill, 137 Ga. 308, 73 S. E. 640. Marking the boundaries of the surface claim as required by statute is one of the first steps towards a location. It serves a double purpose. It operates to determine the right of the claimant as between himself and the general government and to notify third persons of his right. Another seeking the benefits of the law, going upon the ground, is distinctly notified of the appropriation and can ascertain its boundaries. He may thus mark his own location with certainty, knowing that the boundaries of the other can not be changed so as to encroach on grounds duly appropriated prior to the change. The prevention of fraud by swinging or floating is one of the purposes served. Pollard vs. Shively, *supra* (89); Willeford vs. Bell, 5 Cal. Unrep. 679, 49 Pac. 6.

[211] Republic Co. vs. Harris, 202 Ala. 344, 80 So. 426.

[212] Phillpotts vs. Blasdel, 8 Nev. 61.

[213] Doe vs. Waterloo Co., 55 Fed. 11.

[214] Philpotts vs. Blasdell, *supra.*(212)

The name of the lode may be changed by amendatory proceedings. Butte Co. vs. Barker, 35 Mont. 327, 89 Pac. 302, Id. 90 Pac. 177.

[215] Darby vs. Shoop, 116 Va. 848, 83 S. E. 412. An oil well company is liable on the ground of negligence for using an old, worn, and unsafe "bull rope," and by reason of the defective condition of such rope an employee was injured, where it appears that he has no knowledge of the defective condition of the rope. Producers Oil Co. vs. Eaton, 44 Okla. 55, 143 Pac. 9. "First aid" as applied to an injured miner is defined to be immediate attention given to him with the object of arresting hemorrhage, relieving pain, and preserving life until the services of a physician can be obtained. Hunicke vs. Meramic Co., *supra* (26); see Cushman vs. Cloverland Co., *supra.*(26)

[216] Enterprise Co. vs. Rico-Aspen Co., 66 Fed. 205; Id. 167 U. S. 112.

[217] Fellows vs. Willett, ——Okla. ——, 224 Pac. 298. If the evidence establishes to a reasonable certainty the point of location of the obliterated corner the court will not direct the establishment of a corner under the rule of lost corners, since the latter rule establishes the corner where the former surveyor actually located it, and not where it ought to have been located by a correct survey in the first instance. Hale vs. Baugh, 70 Wash. 435, 126 Pac. 942.

CXXIII. Occupant.

An "occupant" of a tract of land, as the word ordinarily is used, is one who has the "use and possession" thereof, whether he resides upon it or not.[218]

CXXIV. Occupation.

The term "occupation" as used in the mining law, is equivalent to possession, and the right to locate is included in the right to occupy, and incident to a location is the right of possession;[219] but mere occupancy of the public lands and making improvements thereon gives no vested right therein as against a location[220] made in pursuance of law.[221]

CXXV. Official Plat of Survey.

The expression in a patent "according to the official plat of the survey of the land returned to the General Land Office by the surveyor-general" refers to the description of the land as well as to the quantity conveyed.[222]

CXXVI. Oil Flotation.

The object of "oil flotation" is to separate metalliferous matter from gangue by means of oils and fatty acids that have a preferential affinity for such metalliferous matter, the principal feature of which is "agitating the mixture to cause the oil-coated mineral to form a froth."[223]

CXXVII. Oral Agreement to Locate.

An agreement to locate need not be in writing. If a party, in pursuance of an "oral agreement to locate" at the expense of another, locates the claim in his own name, he holds the legal title to the ground in trust for the benefit of the party for whom the location was made. Such a party could, upon making the necessary proofs, compel the locator of the mining claim to convey the title to him, although the agreement so to do was not in writing. Such an agreement is not within the statute of frauds.[224]

---

[218] Johnson, L. D. 537.

[219] Tibbitts vs. Ah Tong, 4 Mont. 539, 2 Pac. 761; see, also, Collins vs. Bull, 73 Fed. 739; U. S. vs. Nelson, 27 Fed. Cas. 86; Ladda vs. Hawley, 57 Cal. 55; Hullins vs. Butte Co., 25 Mont. 531, 65 Pac. 1004. To constitute foundation of title, the occupancy must be with the intent or design to acquire the ownership of the thing occupied. No title to mineral land can be acquired by occupancy, unless for the purpose of mining or extracting the mineral. Burns vs. Clark, *supra*.(120)

Mere possession and occupancy of a mining claim, upon which there has been no discovery of mineral, are insufficient grounds for the lawful exclusion from the land of others who seek to make mineral discoveries and development thereon. It is only when such occupancy and possession are accompanied by diligent prosecution of work leading to discovery of mineral that the exclusion of others from the land is justified. Cole vs. Ralph, *supra* (7); Clark and Ohio Oil Co., 48 L. D. 634. See 111, *supra*.

[220] Sparks vs. Pierce, 115 U. S. 408; Hays vs. U. S., 175 U. S. 260; S. P. R. Co. vs. Purcell, 77 Cal. 71, 18 Pac. 886; see Bonner vs. Meikle, 82 Fed. 697; Chism vs. Price, 54 Ark. 251.

[221] Hopkins vs. Noyes, 4 Mont. 556, 2 Pac. 280. Possession is good against mere intruders, but it is not as against one who has complied with the mining laws. Garthe vs. Hart, 73 Cal. 543, 15 Pac. 93. See, also, Nevada Sierra Co. vs. Home Oil Co., 98 Fed. 673; Thallman vs. Thomas, 111 Fed. 277; Malone vs. Jackson, 137 Fed. 878; Miller vs. Chrisman, *supra*.(25)

[222] Sala vs. Crane, 31 Ida. 191, 170 Pac. 94; see, also, Niles vs. Cedar Point Club, 175 U. S. 300; Foss vs. Johnston, 158 Cal. 119, 110 Pac. 294; Round Mt. Co. vs. Round Mt. Co. *supra* (20); and see Schwartz vs. Dibblee, 51 Cal. A. 451, 197 Pac. 125.

[223] Hyde vs. Minerals Sep. Co., 214 Fed. 109; see 242 U. S. 261; Minerals Sep. Co. vs. Miami Co., 237 Fed. 616; Id. 244 Fed. 752; Butte & S. Co. vs. Minerals Sep. Co. 250 Fed. 241, reversed in part and affirmed in part in 250 U. S. 336. See Id. 207 Fed. 956; Minerals Sep. Co. vs. British Syn., 27 R. P. C. 33. A number of patents have been granted in this and other countries, aiming to make practical use of the property of oil and of oil mixed with acid in the treatment of ores, all of which consists of mixing finely crushed or powdered ore with water and oil and sometimes with acid added, and then in variously treating the mass or pulp thus formed so as to separate the oil when it becomes impregnated or loaded with the metal and metalliferous bearing particles from the valueless gangue, and from the resulting concentrate the minerals are recovered in various ways. Minerals Sep. Co. vs. Hyde, 242 U. S. 264.

CXXVIII. Ore.

"Ore" is a compound of metal and other substance,[225] as oxygen, sulphur or arsenic, called its mineralizer, by which its properties are disguised or lost. The term is applied usually to a mineral from which the metal can profitably be extracted, but sometimes is extended also to nonmetallic minerals such as sulphur ore.[226]

CXXIX. Ore Dressing.

When the miner hoists his ore to the surface, the contained metal may be either in the native uncombined state, as, for example, native gold, native silver, native copper, or combined with other substances forming minerals of more or less complex composition, as, for example, telluride of gold, sulphide of silver, sulphide of copper. In both cases the valuable mineral is always associated with minerals of no value. The province of the ore dresser is to separate the "values" from the waste; for example, quartz, feldspar, calcite, by mechanical means, obtaining thereby "concentrates" and "tailings." The province of the metallurgist is to extract the pure metal from the concentrates by chemical means with or without the aid of heat.[227]

CXXX. Ore in Sight.

"Ore in sight" means ore-bearing rock so separated and blocked off by being worked around on two or more sides that it is subject to examination and measurement.[228] Prospective purchasers have a right to rely upon statements as to the amount of ore in sight.[229]

CXXXI. Ore Personal Property.

"Ore," or other mineral product, becomes personal property when detached from the soil in which it is imbedded.[230]

CXXXII. Other Valuable Deposits.

The term "other valuable deposits" includes nonmetalliferous as well as metalliferous deposits.[231]

CXXXIII. Ouster.

An entry by one on the land of another is an "ouster" of the legal possession arising from the title, or not, according to the intention with which it is done. If made under claim and color of right, it is an ouster; otherwise it is a mere trespass. In legal language, the intention guides the entry and fixes its character.[232]

---

[224] Book vs. Justice Co., *supra*.(15) The mining laws do not prohibit a person from initiating a location of a mining claim by an agent, as it is not necessary that he should personally act in taking up a mining claim, or in doing acts required to give evidence of an appropriation, or to perfect the appropriation. McCulloch vs. Murphy, 125 Fed. 149, see, also, U. S. vs. California Midway Oil Co., *supra*.(140)

[225] Marvel vs. Merritt, 116 U. S. 11; Hemstead & Son. vs. Thomas, *supra*.(155) Courts can not take judicial notice of what percentage of mineral can be extracted from a particular class of ore. This is a matter of proof in each particular case. Dixon vs. S. P. Co., 42 Nev. 73, 172 Pac. 370.

[226] The Santa Clara, *supra*.(74)

[227] The Santa Clara, *supra*.(74)

Courts will take judicial knowledge of the fact that processes of crushing, amalgamating, and cyaniding ores will not effect an extraction of 100 per cent of the metallic content. What will be a reasonable percentage of extraction will depend largely upon the process used and the character of the ore. Dixon vs. S. P. Co., *supra*.(225)

[228] Mudsill Co. vs. Watrous, *supra* (42); see Green vs. Turner, 86 Fed. 837. As to measurement of ore under water, see Ward vs. Eastwood, 3 Cal. A. 437; 86 Pac. 742.

[229] Green vs. Turner, *supra* (228); see Southern Dev. Co. vs. Silva, 125 U. S. 247; see, also, Johnson vs. Withers, 9 Cal. A. 52, 98 Pac. 42.

[230] Forbes vs. Gracey, *supra* (21); see Waskey vs. McNaught, 163 Fed. 929; Kelvin Co. vs. Copper Co., —— Tex. C. A. ——; 203 S. W. 68.

[231] Harry Lode, *supra*.(7)

CXXXIV. Outstroke and Instroke.

The term "outstroke" means the raising or removal of ore from a mine adjoining the demised premises through a shaft or opening on the latter. The term "instroke" means the right to raise or take ore from a leased mine through the shaft or tunnel of an adjoining mine.[233]

CXXXV. Pedis Possessio.

The term "pedis possessio" means actual possession.[234]

CXXXVI. Photographs.

1. Where a plain picture or representation produced by the art of photography is verified as a correct representation of the locality in question,[235] it is admissible in evidence to enable the court or a jury to understand and apply the established facts to the particular case. Such photographic scenes are admissible as appropriate aids to the jury in applying evidence, whether it relates to things or places.[236]

2. Proving Photograph. Testimony that a "photograph" is a correct representation of the object sought to be shown is a sufficient foundation for its admission. Such testimony need not necessarily be given by the photographer who took or finished the "photograph" but may be given by any witness having sufficient knowledge of the object to say that the "photograph" is a faithful representation thereof.[237]

3. Common Practice. It is a common practice to use maps, models and photographs to illustrate evidence.[238]

CXXXVII. Pillars or Stumps.

"Pillars" or "stumps" are the natural supports left in the mine for the purpose of supporting the roof.[239]

CXXXVIII. Placers.

The term "placers" as used in the Mining Act, means ground within defined boundaries chiefly valuable for its deposits, metallic or nonmetallic, in earth, sand or gravel, not in place, that is, in a loose state, upon or near the surface or occupying the bed of ancient rivers or valleys and may, in most instances, be collected by washing or amalgamation.[240] In other words, the term "placers" includes all forms of deposit excepting veins or lodes of quartz or other rock in place.[241]

---

[232] Zerres vs. Vanina, 134 Fed. 614. When another enters upon a mining claim, asserting ownership therein, by virtue of an alleged superior title based upon a location, and exercises dominion over it to the exclusion of the rights of the owner this amounts to an ouster. Bramlett vs. Flick, 23 Mont. 95, 57 Pac. 869.

[233] Percy Co. vs. Newman Co., 300 Fed. 142. The right to mine by instroke goes to the lessee by implication, but the right to mine by outstroke is excluded except where specially covenanted for in the lease, because in outstroke working, on the other hand, the lessee makes use of lessor's mine for a purpose not implied in the lease. Such a right can not be inferred. White on Mines and Mining Remedies, § 136; Stewart on Mines and Mining, pages 115, 116; McSwinney on Mines, (5th ed.), page 443; see, also, Barringer & Adams, Mines and Mining, page 578. See, generally, Sharum vs Whitehead Co., 223 Fed. 282; Schobert vs. Pittsburgh Co., 254 Ill. 474, 98 N. E. 945; Trustees vs. Lehigh Co., 236 Pa. St. 945, and see Bagley vs. Republic Co., 193 Ala. 219.

[234] Southern Ry. Co. vs. Hall, 145 Ala. 224, 41 So. 136; Goldberg vs. Bruschi, *supra*.(3) The actual possession of a mining claim is sufficient evidence of title as against a mere intruder. Campbell vs. Rankin, *supra*(187); see, also, Del Monte Co. vs. Last Chance Co., *supra*.(185)

[235] Delerich vs. Salt Lake Co., 14 Utah 137, 46 Pac. 656.

[236] Harris vs. Seattle Co., 65 Wash. 27, 117 Pac. 601; Hassam vs. Safford, 82 Vt. 444, 74 Atl. 197.

[237] Berkovitz vs. American River Co., 191 Cal. 195, 215 Pac. 675.

[238] Delerich vs. Salt Lake Co., *supra*.(235)

[239] Northeast Co. vs. Hunley, 163 Ky. 817, 174 S. W. 732.

CXXXIX. Placer Location.

A "placer location" is a location of a tract of land for the mineral-bearing or other valuable deposits upon or within it that are not found within lodes or veins in rock in place, and is a claim of a tract of land for the sake of the loose deposits on or near its surface.[242]

CXL. Placer Mining.

"Placer mining" simply is extracting the gold from placers, wherever situated—in dry channels and in channels for the time filled with water. It does not make the process any the less "placer mining" that the gold is found in deep channels, in navigable streams, or in estuaries or creeks and rivers where the sea ebbs and flows.[243]

CXLI. Pop Shots.

A "pop shot" is a shot by which a boulder in a mine is broken up by placing a stick of dynamite on top of the boulder and exploding it.[244]

CXLII. Preference.

The term "preference" is a familiar one under the public land laws and means "exclusive."[245]

CXLIII. Proceedings.

The term "proceedings" is broader than the term "action" yet the term "proceedings" in the mining law is used in the sense of "action" and refers to the commencement of an action. And the term "proceedings" is used to enable a party to institute such proceedings under the different forms of actions allowed by the state and federal courts.[246]

CXLIV. Process of Mining.

The "process of mining" is the prospecting or developing of ground by shaft, tunnel, or other opening, whether mineral is extracted at a profit or at all; by quarrying; or by dredging the bed or banks of a water-way for the purpose of obtaining mineral therefrom.[247]

CXLV. Prospect Hole.

A "prospect hole" adds nothing to the value of the land but only tends to show its actual condition.[248]

---

[240] U. S. vs. Iron Co., 128 U. S. 673; N. P. R. Co. vs. Soderberg, *supra*,(72) Clipper Co. vs. Eli Co., *supra* (110); Cole vs. Ralph, *supra* (7); Gregory vs. Pershbaker, 78 Cal. 109, 14 Pac. 401; Moxon vs. Wilkinson, 2 Mont. 421; Sullivan vs. Schultz, 22 Mont. 541, 57 Pac. 279.

[241] Cosmos Co. vs. Gray Eagle Co., 104 Fed. 20, 112 Fed. 4, 190 U. S. 301; Webb vs. American Co., *supra* (138); Gregory vs. Pershbaker, *supra*.(240)

[242] Webb vs. American Co., *supra* (138); see Clipper Co. vs. Eli Co., *supra* (110); Duffield vs. San Francisco Co., 205 Fed. 486; Gregory vs. Pershbaker, *supra* (240); Bay vs. Oklahoma Co., 13 Okla. 429; 73 Pac. 936. The rights conferred and the conditions upon which they are held are different in placer claims and lode claims. U. S. vs. Iron Co., *supra*,(240)

[243] Ball vs. Tolman, *supra*.(117) See, also, Richen vs. Davis, 76 Or. 311, 148 Pac. 1130.

[244] Batesel vs. American Zinc Co., 190 Mo. A. 231, 176 Sev. 447.

[245] Morrison, 36 L. D. 128; see U. S. vs. Forrester, 211 U. S. 403.

[246] Mars vs. Oro Fino Co., 7 S. D. 617, 65 N. W. 19, see Chambers vs. Harrington, *supra* (131); Cronin vs. Bear Creek Co., 3 Ida. 614, 32 Pac. 204; Mattingly vs. Lewisohn, 13 Mont. 508, 19 Pac. 310; Golden Fleece Co. vs. Cable Con. Co., 12 Nev. 312.

[247] Johnson vs. California Lustral Co., *supra*.(160)

[248] Tyson Creek Co. vs. Empire Mill Co., 31 Ida. 580, 174 Pac. 1006. For the value of a prospect hole for oil, caused to be drilled by a lessee of oil and gas lands, but not completed, see North Healdton Co. vs. Skelley, —— Okla. ——, 158 Pac. 1182.

CXLVI. Prospecting and Mining.

"Prospecting" and "mining" are generic terms which include the whole mode of obtaining metals and minerals.[249]

CXLVII. Protestant.

A person who has filed no "adverse claim" during the period of publication and comes forward and presents objections to the granting of a patent is a "protestant."[250]

CXLVIII. Provisional Locations.

A location can not depend for its validity upon the subsequent forfeiture or abandonment of the claim by the present claimant.[251]

CXLIX. Public Domain.

The term "public domain" is equivalent to the term "public land."[252]

CL. Public Land.

The term "public land" as used in the legislation of congress means such lands as are subject to appropriation as a mining claim[253] or subject to sale, or other disposition, under the general laws.[254]

CLI. Public Mineral Land.

"Public mineral land" is land belonging to the United States containing a deposit of mineral in some form, metalliferous or nonmetalliferous, in quantity and quality sufficient to justify expenditures in the effort to extract it and subject to occupation and purchase under the mining laws.[255]

CLII. Public Land and Public Use.

There is a clear distinction between public lands and lands that have been severed from the public domain and reserved from sale or other disposition under general laws. Such reservation severs the land from the mass of the public domain and appropriates it to a "public use."[256]

CLIII. Pusher—Jigger Boss.

"Pusher" or "jigger boss" is a term used in mining parlance to designate one who is engaged for the purpose of encouraging or hastening the miners.[257]

---

[249] Williams vs. Toledo Co., 25 Or. 426, 36 Pac. 426; see Bishop vs. Baisley, *supra*.(179)

[250] Smuggler Co. vs. Trueworthy Lode Claim, 19 L. D. 356; see Tilden vs. Intervenor Co., 1 L. D. 572.

[251] Mason vs. Washington-Butte Co., 214 Fed. 32; Rooney vs. Barnette, 200 Fed. 700; see, also, Slavonian Co. vs. Perasich, 7 Fed. 232.

[252] Barker vs. Harvey, 181 U. S. 490.

[253] 5 U. S. Comp. St., p. 5414, § 4614. See Erhardt vs. Boaro, *supra* (4); Deffebach vs. Hawke, *supra* (72); see, also, South End Co. vs. Tinney, *supra*.(108) Land not known to be mineral is not "public mineral land" within the meaning of the statute. Smith vs. Hill, 89 Cal. 129, 26 Pac. 644.

[254] Newhall vs. Sanger, 92 U. S. 761; Barden vs. N. P. R. Co., 154 U. S. 288; U. P. R. Co. vs. Harris, 215 U. S. 388; McFadden vs. Mt. View Co., 97 Fed. 670; U. S. vs. Blendauer, 122 Fed. 703.

In the legislation concerning the public lands it has been the practice of congress to make a distinction between mineral lands and other lands, to deal with them along different lines and to withhold mineral lands from disposal save under the laws specially including them, U. S. vs. Sweet, 245 U. S. 567.

[255] Pacific Coast Co. vs. N. P. R. Co., *supra* (90); see Deffebach vs. Hawke, *supra* (72); Alford vs. Barnum, 45 Cal. 482. Federal statutes opening mineral lands to entry apply to only such lands as the United States has indicated are held for disposal under land laws. Oklahoma vs. Texas, 258 U. S. 574.

[256] U. S. vs. Tygh Co., 76 Fed. 693.

[257] Ryan vs. Manhattan Co., 38 Nev. 92, 145 Pac. 908.

CLIV. Quarry.

A "quarry" in its proper significance is a "stone mine"[258] and may be located as a placer claim.[259] It is distinguished from a mine in the fact that usually it is open at the top and front, and in the ordinary acceptation of the term, in the character of the material extracted.[260]

CLV. Real Property.

The term "real property" includes mining claims,[261] dumps,[262] water rights,[263] and ditches.[264]

CLVI. Relinquishment.

A "relinquishment" turns the land back to the United States, and with it every right, possessory or otherwise, that the relinquisher enjoyed.[265]

CLVII. Rule of Approximation.

The "rule of approximation" now is applicable to placer mining locations and entries upon surveyed lands, to be applied on the basis of ten-acre legal subdivisions.[266]

CLVIII. Saddle.

A "saddle" is a peculiar formation of sand slate found in shale or sand rock and may be surrounded by soapstone. The under or exposed side of a saddle looks like natural rock, but its upper side is smooth, having no particular bond with the sand rock with which it is embedded, and is liable to fall out of its place; a fall, however, producing no other derangement of the surrounding parts of the room from which it falls.[267]

CLIX. Salines.

Salt mines of rock salt, mineral springs, salt springs, salt beds and salt rock all come within the meaning of the general term "salines."[268]

CLX. Salting.

"Salting" consists in placing, usually surreptitiously, valuable mineral from a foreign source in such form and place within the claim as the characteristics of the latter may require, or, in like manner, tampering with the samples of ore or mineral taken therefrom or with the assays thereof, or the amalgam or other matter in the mill or other reduction works, with the intent and for the purpose to thereby give increased apparent, but misleading and inflated value to the property, which is the subject of the option or contract of sale thereof and so induce its sale at a price greater than its mineral value warrants.[269]

---

[258] In re Kelso, 147 Cal. 609, 82 Pac. 241; see Quincy Co., 147 Fed. 279; see, generally, Nephi Co. vs. Juab County, 33 Utah 114, 93 Pac. 53.

[259] Pacific Coast Co. vs. N. P. R. Co., *supra* (90); Meiklejohn vs. Hyde, 42 L. D. 147; Freezer vs. Sweeney, 8 Mont. 233, 21 Pac. 20; see Clark vs. Ervin, 17 L. D. 550. See, generally, Burdick vs. Dillon, 144 Fed. 741, U. S. vs. Ohio Oil Co., 240 Fed. 996.

[260] In re Kelso, *supra* (258); see, generally, Bell vs. Wilson, L. R. 1 Ch. 309; Davill vs. Roper, 24 L. J. Ch. 779; Glasgow vs. Fairie, *supra* (166); American Onyx Co., 42 L. D. 417; Marvel vs. Merritt, 116 U. S. 11, Heysradt vs. Delaware Co., 151 Fed. 321; J. M. Guffey Co. vs. Murrel, *supra* (164); Shaw vs. Wallace, 25 N. J. Law 462; Miller vs. Chester Co., *supra* (93); Rutledge vs. Kress, 17 Super. Ct. 495; Murray vs. Allred, *supra.* (159)

[261] Bradford vs. Morrison, 212 U. S. 395; see Jones vs. Peck, *supra,* (19) and see Van Ness vs. Rooney, 160 Cal. 131, 116 Pac. 392.

[262] Savage vs. Nixon, *supra* (97); Steinfeld vs. Omega Co., *supra,* (97) see, also, Manson vs. Dayton, 153 Fed. 263.

[263] Bree vs. Wheeler, 4 Cal. A. 109, 61 Pac. 782.

[264] Gest vs. Packwood, 34 Fed. 368; Smith vs. O'Hara, 43 Cal. 371; Burnham vs. Freeman, 11 Colo. 601, 17 Pac. 761.

[265] Moss vs. Dowman, 176 U. S. 413; Robinson vs. Lundrigan, 227 U. S. 180; Kendall vs. Bunnell, 56 Cal. A. 112, 205 Pac. 78. For insufficient form of a relinquishment see Bojorques vs. Heilm, 50 L. D. 165.

[266] McKittrick Oil Co., 44 L. D. 340.

[267] Lehigh Valley Co. vs. Wasko, 231 Fed. 42, 48.

[268] Southwestern Co., 34 L. D. 603. The term "mineral lands" is one of broader significance than the words "lands on which are situated any known salines or mines," and the former refers to a class of lands rather than to specified tracts easily ascertainable, not only by the Land Department, but by the applicants themselves. Old Dominion Co. vs. Haverly, 11 Ariz. 254, 90 Pac. 333; see Cosmos Co. vs. Gray Eagle Co., *supra.* (241)

CLXI. Salt Lick.

A "salt lick" is so-called in the western country from the fact that deer and other wild animals resort to it, and lick or drink the brackish water. And in this respect no distinction is perceived between a "lick" as frequently used and a "salt spring."[270]

CLXII. Safe Appliances.

The term "safe" when used in respect to appliances to be furnished by an employer to an employee means "reasonably safe," and "reasonably safe" means such tools as are in general use among employers of ordinary caution and prudence in the same line of business under the same circumstances.[271]

CLXIII. Safe Place.

The rule that a mine operator or other employer must exercise reasonable care to furnish a miner or an employee with a "safe place" in which to work does not apply where the miner or employee is himself creating the place in which he works, or where the danger was such as was created by the miner or employee in the progress of his work.[272]

CLXIV. Scrip.

1. "Scrip," sometimes called "indemnity certificates" and sometimes "land warrants," is a document created by legislative enactment, whereby the holder thereof is entitled to acquire public nonmineral land, in the certain quantity therein named upon its surrender to the officers of the land office for the district of lands subject to sale and wherein the selected lands may lie, or as otherwise provided by the law authorizing its creation.[273]

2. Selection. The "scrip" may be laid upon unoccupied surveyed or unsurveyed nonmineral land [274] as the terms of the particular act providing for its issuance may permit. When the entry is made the land is withdrawn from the public domain.[275]

3. Assignment and Sale. The "scrip," generally, is subject to assignment and sale in the open market. Its price per acre is governed by the law of supply and demand.

4. Guarantee. The seller of the "scrip" should, properly, guarantee its acceptance by the government, as the doctrine of "bona fide purchaser" does not apply to one who purchases the "scrip."[276]

---

[269] See Schamel on Mining Law, page 316; Mudsill Co. vs. Watrous, *supra*.(42) See, also, Southern Development Co. vs. Silva, *supra* (229); Cook vs. Johnson, 3 Alaska 519; Healey vs. Rupp, *supra*.(42)

[270] Indiana vs. Miller, 13 Fed. Cas. 7022; see, also, New Mexico, 35 L. D. 5.

[271] Lively vs. American Co., 137 Tenn. 261, 191 S. W. 977.

[272] New Hughes Co. vs. Gray, 173 Ky. 337, 191 S. W. 79; see, also, Big Vein Co. vs. Repass, 238 Fed. 334.

[273] See Opinion, 28 L. D. 472.

[274] Weise, 2 C. L. O. 130; Valle, 2 C. L. O. 178; Letter, 3 C. L. O. 83; see Burgess, 20 L. D. 502; Florida, 45 L. D. 469; Van Dyke Co. vs. Malott, 50 L. D. 326; Martin, 48 L. D. 277.

[275] James vs. Germania Co., 107 Fed. 597.

[276] Pettigrew, 2 L. D. 598; see James vs. Germania Co., *supra* (275); Van Dyke Co. vs. Malott, *supra*.(274) For case involving "scrippers" and oil locators, see McLemore vs. Express Co., *supra*.(77)

CLXV. Seam.

In geology a thin layer or stratum of rock is called a "seam." The term is also applied to coal. "Vein or coal," "coal bed" and "coal seam" are equivalent terms.[277]

CLXVI. Shift.

The word "shift" means a set of workmen who work in turn with other shifts, as a night shift.[278] It means, also, a day's work.[279]

CLXVII. Shift Boss.

The term "shift boss" means a master workman who directs the work of the set of men engaged upon a particular shift; that is, the set of workmen who work in turns with other sets.[280]

CLXVIII. Shoestring Location.

A "shoestring location" is a location of a long and narrow strip of mineral land.[281]

CLXIX. Skips.

"Skips" or cars are operated from the surface by cables attached to a drum which in turn is operated by an engine. The cars or "skips" are used by the employees of the mine owner to enter and leave the mine and also for the lowering of supplies into and the taking of ore from the mine.[282]

CLXX. Slag.

"Slag" is a refuse from metallic ores after being smelted.[283]

CLXXI. Slope.

The term "slope" in a mining statute or in mining parlance means an inclined way, passage, or opening used for the same purpose as a shaft and is sometimes used as embracing the main haulage passageway, whether inclined or level.[284]

---

[277] Chapman vs. Mill Creek Co., 54 W. Va. 193, 46 S. E. 263. The discovery of seams containing mineral-bearing rock similar in character to seams or veins of mineral matter that had induced other miners to locate claims in the same district, and which by development were found to be a part of a well-defined lode or vein containing ore of great value, constitutes a discovery. Jefferson-Montana Co., 41 L. D. 320 *supra* (141); see Harper vs. Hill, *supra*.(10)

A discovery made in running a tunnel where there were small seams of iron oxide, quartz, and small quantities of carbonate of lead, and where the indications were of a character which the miners of that district would follow in the expectation of finding ore, and where the rock in such seams was different from the country rock, and where such seams were similar in character to the seams or veins of mineral matter that has induced other miners to locate claims in the same district, is a sufficient discovery to justify a belief in the existence of a lode or vein of great value, and to show that the location was made in good faith and not upon a conjectural or imaginary existence of a vein or lode, which can not be permitted. Shoshone Co. vs. Rutter, *supra* (141); see King vs. Amy Co., 152 U. S. 227; Lange vs. Robinsin, 148 Fed. 802; Jefferson-Montana Co., 41 L. D. 322. In any case it may be an open question whether a location includes lands valuable for minerals, or whether it is based upon a barren seam or fissure. Montana Co. vs. Migeon, 68 Fed. 814; Rough Rider Claims, 41 L. D. 253; see Madison vs. Octave Oil Co., *supra*,(42) 99 Pac. 176.

[278] Johnson vs. Butte & S. Co., *supra*.(53)

[279] Haney vs. Texas Co., —— Tex. C. A. ——, 207 S. W. 375.

[280] Johnson vs. Butte & S., *supra*.(53)

[281] Hanson vs. Craig, 170 Fed. 65, Snowflake Fraction, 37 L. D. 250. See Dripps vs. Allison's Co. 45 Cal. A. 95, 187 Pac. 448.

[282] Moreno vs. New Guadalupe Co., 35 Cal. A. 744, 170 Pac. 1088.

[283] Baltimore Co. vs. Carnegie Co., 251 Fed. 685. The term "tailings" has been construed as including slag. Boston Co. vs. Montana Co., 121 Fed. 526. The owner of material like slag, the refuse of mineral deposit dug from the earth, run through a mill, and then dumped upon the surface of contiguous land, may be treated and dealt with as mere personalty, which the owner may sell and deliver as any other personal property susceptible of manual delivery. Manson vs. Dayton, *supra*.(26)

[284] Roberts vs. Tennessee Co., 255 Fed. 471.

CLXXII. Smelter Returns.

The phrase "smelter returns" in a contract means returns from the ore, less the smelting charges, without deducting transportation charges.[285]

CLXXIII. Smelting.

"Smelting" by its derivation is synonymous with "melting." When metallic ores are exposed to heat, and such reagents as develop the metal, it is called "smelting" in contradistinction from the mere application of heat, causing the ore to become fluid, which is called "smelting."[286]

CLXXIV. Stabber.

The term "stabber" is employed in the work of tubing oil and gas wells to the person whose duty it is to guide the joints suspended by a rope from the derrick to connect with other joints, placed in the well.[287]

CLXXV. Sludge.

"Sludge" is a murky colored sediment flowing from the operations of a lead and zinc mining plant.[288]

CLXXVI. Stake.

A "stake" is not a post. The latter signifies more permanence, and to stick it in the ground requires more effort and outlay than to drive down a stake. It suggests larger proportions, is more readily seen than a stake.[289]

CLXXVII. Stope.

The term "stope" is defined as the working above and below a level where the mass of the orebody is broken—also an excavation for the extraction of ore. A stope is the very antithesis of a shaft, tunnel, drift, winze or other similar excavation in a mine.[290]

---

[285] Frank vs. Bauer, 19 Colo. A. 445, 75 Pac. 930; see, also, Guild Co. vs. Mason, 115 Cal. 95, 46 Pac. 901; Con. Kansas Co. vs. Gonzales, 50 Tex. A. 79, 109 S. W. 946; Blanck vs. Pioneer Co., 98 Wash. 261, 159 Pac. 1077.

[286] Lowrey vs. Cowles Co., 68 Fed. 369, Id. 79 Fed. 331.

The business of smelting is a part of the operation of mining, although it may be distinct from that of digging or mining the ore. U. S. vs. Gratiot, 39 U. S. 538; U. S. vs. United Verde Co., 196 U. S. 212; U. S. vs. Richmond Co., 40 Fed. 415.

[287] Long vs. Foley, 82 W. Va. 502, 96 S. E. 794.

[288] Dickensheet vs. Chouteau Co., 200 Mo. A. 150, 202 S. W. 625.

[289] U. S. vs. Sherman, *supra*.(142) See Upton vs. Larkin, 7 Mont. 449, 17 Pac. 728. Parol evidence in case of uncertain and disputed boundaries is not admissible to show a stump as a monument where the record calls for a post. Pollard vs. Shively, *supra* (89); Duncan vs. Eagle Rock Co., *supra*.(151)

[290] Creede Co. vs. Hawman, 33 Colo. A. 125, 127 Pac. 926; Mesich vs. Tamarack Co. 184 Mich. 363, 151 N. W. 565. In Fisher vs. Central Co., 156 Mo. 479, 56 S. W. 1107, the word "stope" is defined to mean "the excavation made in a mine to remove the ore which has been rendered accessible by the shaft or drift." Mr. Schamel, in his work on Mining Law (page 19), says: "The idea of a stope implies that the excavation is temporary and only kept open until the ore is removed, after which it is allowed to cave in or become filled with waste rock, etc., while shafts or drifts are permanent openings for passing to and from the place where mining is being done and for transporting the mineral."

"Overhand stoping" is a method of working out the contents of a vein by advancing from below upward, the miner being thus always helped by gravity. It is the method most commonly employed. That part of the material thrown down which is worth saving is raised to the surface, and the refuse rock (attle or deads) resting on the stulls remains in the excavation, helping to support the walls of the mine, and giving the miner a place on which to stand. Cent. Dict.

"Underhand stoping" is excavating the ore by working from above downward. In underhand stoping everything loosened by blasting has to be lifted up to be got out of the way. The advantage of this method is that in case the ore is very valuable less of it need be lost by its getting so mixed with the attle that it can not be picked out. Cent. Dict.

A "filled stope" may be defined as one where waste rock is left on the floor of the stope, thus raising the floor as the work proceeds. Creede Co. vs. Hawman, *supra*.

CLXXVIII. Strikes.

1. A "strike" is a combined effort among workmen to compel the employer to the concession of a certain demand by preventing the conduct of his business until compliance with the demand.[291]

2. Strikes Lawful. A "strike" is lawful. It only becomes unlawful when the means employed to carry it out are unlawful, or when it maliciously is originated to attain an unlawful end.[292]

3. Right of Employees to Strike. An employee, or any number of employees, in the absence of a contract to work a definite time, has a right to quit the service of the employer without any reason, or for any reason he may regard satisfactory to himself. The employees of a mining company have a right to protest to the employer against the employment or retention of a nonunion employee and to make the discharge of such nonunion employee a condition to their continuation in his employment. That unless such nonunion employee is discharged the union employees will strike, or the equivalent, will simultaneously cease to work. If, under such circumstances, the nonunion employee is discharged by the common employer he has no cause of action against either the union as an organization or the members thereof as individuals.[293]

4. Labor Unions. The growth and necessities of the great labor organizations have brought affirmative legal legislation of their existence and usefulness and provision for their protection, which their members have found it necessary. Their right to maintain "strikes," when they do not violate the law or the rights of others, has been declared.[294]

5. Acts Enjoined. When officers and agents of the United Mine Workers of America attempt to reorganize and unionize a mine the operator is entitled to an injunction restraining them from acts and conduct: (1) Interfering or attempting to interfere with his miners for the purpose of unionizing the mine without his consent, by representing to the miners employed that they will suffer, or are likely to suffer some loss or trouble in continuing in or in entering the employment of the operator by reason of his not recognizing the union or because he runs a nonunion mine; (2) interfering or attempting to interfere with the operator's miners employed for the purpose of union-

---

[291] Farmers Co. vs. N. P. R. Co., 60 Fed. 802; see, also, Longshore Co. vs. Howell, 26 Or. 527. The term "legal strike" has been said to mean a strike declared in pursuance of the rules of the order. Toledo Co. vs. Penn. Co., 54 Fed. 733. The interruption of operations by strikes is provided for in §§7 (2 Supp. U. S. Comp. St., p. 1406, § 4640¼ee,) and § 11 (Id. p. 1408, § 4640¼ee) of the Land Leasing Act.

[292] Kolley vs. Robinson, 187 Fed. 415. To instigate a sympathetic strike in aid of a boycott is not permissible under the Clayton Act, prohibiting injunctions in certain cases. Pacific Co. vs. International Typo. Union, 125 Wash. 273, 216 Pac. 358. The right of an employee to strike does not give an outsider a right to instigate a strike. Montgomery vs. Pacific Electric Co., 293 Fed. 683.

[293] Roddy vs. United Mine Workers of America, 41 Okla. 621, 139 Pac. 126; see, also, Mitchell vs. Hitchman, 245 U. S. 229; Bittner vs. West Virginia Co., 214 Fed. 717: It is the right of every man to engage to work for or to deal with any man or class of men as he sees fit, whatever his motive or whatever the resulting injury, without being held in any way accountable therefor. Parkinson vs. Building Trades, 154 Cal. 599, 98 Pac. 1027; Pierce vs. Stablemen's Union, 156 Cal. 75, 103 Pac. 324. These rights may be exercised in association with others so long as they have no unlawful object in view. Overland Co. vs. Union Lith. Co., 57 Cal. A. 366, 207 Pac. 412.

[294] United Mine Workers of America vs. Coronado Co., 259 U. S. 385.

Union miners have a right by peaceful methods to persuade other miners not to work in a non-union mine; but they have no right to attempt such result by violence or intimidation. A mining company is within its rights in refusing to employ union men and in discharging those who join a union, and the company is entitled to protection against unlawful invasions of such rights. Tosh vs. West Kentucky Co., 252 Fed. 44. For a discussion of the relative rights of mine owners and miners, see Mitchell vs. Hitchman Co., 214 Fed. 715; Bittner vs. West Virginia Co., *supra.*(293)

izing the mine without his consent and in aid of such purpose knowingly and wilfully bringing about the breaking by the miners of contracts of service known to exist with the employer and present and future employees; (3) knowingly and wilfully enticing the operator's employees to leave his service on the ground that he does not recognize the United Mine Workers of America or runs a nonunion mine; (4) interfering or attempting to interfere with the operator's employees so as knowingly and wilfully to bring about the breaking by the employees of their contracts of service known to exist, especially from knowingly and wilfully enticing the employees to leave the employer's service without his consent; (5) trespassing on or entering upon the grounds and premises of the employer or his mine for the purpose of interfering therewith or hindering or obstructing the business or with the purpose of compelling or inducing by force, intimidation, violence, or abusive language or persuasion, any of the employer's employees to refuse or to fail to perform their duties as such; (6) compelling or inducing or attempting to compel or induce by threats, intimidation, or abuse or violent language, any of the employer's employees to leave his service or to fail or refuse to perform their duties as such employees or compelling or attempting to compel by like means any person desiring to seek employment at the employer's mine and works from so accepting employment therein.[295]

6. Persons Bound by Injunction. An injunction is binding not only upon the particular persons named, but upon all persons participating in the acts charged and mentioned therein who have actual knowledge of the injunction; and all such persons may properly be punished as for contempt of court in violating the injunction.[296]

CLXXIX. Superintendent.

A "superintendent" is one who superintends; a director; an overseer.[297]

CLXXX. System.

The term "system" or "general system of work" means simply this: that the work as it is commenced on the ground is such that, if continued, will lead to a discovery and development of the veins or orebodies that are supposed to be in the claim, or, if these are known, that the work will facilitate the extraction of the ores and mineral.[298]

---

[295] Mitchell vs. Hitchman Co., *supra.*(293) A restraining order against picketing will advise labor's earnest advocates that the law does not look with favor on an enforced discussion of the merits of the issue between individuals who wish to work, and the groups of those who do not, under conditions which subject the individuals to work to a severe test of their nerve and physical strength and courage. American Foundries vs. Tri-State Council, 257 U. S. 206. The "Clayton Act." (§20) is discussed and compared with English Trades Dispute Act of 1906, from which said statute was taken, in Great Northern Ry. Co. vs. Brosseau, 286 Fed. 414. Where an injunction against certain union miners has been issued, restraining violence against the property and non-union employees of a mining company, language or conduct intended to incite others to violence and to a violation of the court's order constitutes a punishable contempt. U. S. vs. Colorado, 216 Fed. 654. For a case involving "boycotting" see Truax vs. Corrigan, 257 U. S. 312 rev'g 20 20 Ariz. 7. See, also, Duplex Co. vs. Deering, 254 U. S. 443; also 16 A. L. R. 196.

For a discussion of state laws requiring corporations to issue to employees when discharged from or voluntarily leaving their service, letters setting forth the nature of the services rendered by such employees, and its duration, with a true statement of the cause of discharge or leaving, see Prudential Co. vs. Cheek, 259 U. S. 530; Chicago Co. vs. P. R. Co., 259 U. S. 548.

[296] In re Lennon, 166 U. S. 548; Tosh vs. Kentucky Co., *supra.*(4)

[297] St. Louis Co. vs. DeFord, 38 Kan. 299, 16 Pac. 442.

[298] Nevada Ex. Co. vs. Spriggs, 41 Utah 181, 124 Pac. 770.

CLXXXI. Taking Timber Necessary to Support Their Improvements.

The term "taking timber necessary to support their improvements" applied to a miner means all the timber he might need to make the working of his mine possible.[299]

CLXXXII. This Vein.

A notice claiming a location upon "this vein" has only one meaning.[300] It raises an inference that the notice was posted upon or in close proximity to a vein or lode:[301] although, as a fact, no vein or lode then was exposed.[302]

CLXXXIII. Timbering.

By "timbering" is meant the protecting against falls of roof formation of a mine, by means of horizontal timbers or caps extending across the passageway just under the roof, the ends of such timbers resting upon the vertical timbers or posts.[303]

CLXXXIV. Tool Nipper.

"Tool nipper" is a term applied to a person whose duty it is to carry powder and sharpen drills and tools used in a mine down to the various levels of the mine and to bring back such tools and drills as have been dulled by use to the surface.[304]

CLXXXV. Top and Apex.

The words "top" and "apex" as applied to mineral veins were not a part of the miner's terminology prior to the adoption of the federal mining law, but were words used by legislators to convey the intent of the formulators of that law.[305]

CLXXXVI. To the Same Extent.

The clause "to the same extent as if discovered from the surface" is used in section 2323 Revised Statutes in its natural and customary sense, and it measures the extent, the distance along the vein or lode to which the right of possession given by the statute extends, and not to the general benefits conferred by the discovery.[306]

CLXXXVII. Trap.

"Trap" or "trap rock," a general name for dark, fine-grained rock, found in broken-up fragments within a limited area, which is particularly suitable and can be profitably marketed for ballast, is, when the land within which it is contained is chiefly valuable for such, a valuable mineral deposit subject to appropriation and patent under the placer-mining laws.[307]

---

[299] Instructions, 1 L. D. 602; see Teller vs. U. S., 113 Fed. 280; and see, Benson Co. vs. Alta Co., *supra* (103); U. S. vs. Rizzinelli, 182 Fed. 681.

[300] Phillpotts vs. Blasdell, *supra* (212); see Daggett vs. Yreka Co., *supra*.(151) See East Tintic Co., 41 L. D. 256.

[301] Daggett vs. Yreka Co., *supra*.(151)

[302] Book vs. Justice Co., *supra* (15); see Willeford vs. Bell, *supra* (210); 49 Pac. 6; Daggett vs. Yreka Co., *supra*.(151)

[303] Eagle Co. vs. Patrick, 161 Ky. 333, 170 S. W. 961.

[304] Moreno vs. New Guadalupe Co., *supra* (282)

[305] Jim Butler Co. vs. West End Co., *supra*.(39) A controversy as to what is the top or apex of a vein or lode is a question of fact to be determined by evidence, and not one of law, as these are not scientific expressions, but words in common use. Blue Bird Co. vs. Largey, 49 Fed. 291. The question of the ownership of a vein or lode depends upon whether the top and apex of such vein or lode is in one place or another. Stevens vs. Gill, 23 Fed. Cas. 13; see Stevens vs. Williams, 23 Fed. Cas. 40, and see Iron Co. vs. Cheesman, 116 U. S. 533; King vs. Amy Co., 152 U. S. 227; Black vs. Elkhorn Co., *supra*.(1)

[306] Enterprise Co. vs. Rico-Aspen Co., 66 Fed. 204; Ellet vs. Campbell, 18 Colo. 526, 33 Pac. 521; Id. 167 U. S. 119.

CLXXXVIII. Trespass.

An intrusion upon land occupied by another for the purpose of locating a mining claim is but a naked trespass and initiates no right;[308] although the occupant has no other valid title than posession.[309]

CLXXXIX. Tungsten.

"Tungsten," in the metallic state, is one of the rare elements, occurring neither in nature nor the arts. In the pure metallic state the metal is considered only as a curiosity. Metallic tungsten is obtained by reducing. It is inorganic. It has a definite chemical composition. Its properties as a metal are disguised and lost in its mineralizer compound. Tungsten ore has none of the characteristics of metals. It has neither elasticity, ductibility, malleability, resonance, nor luster. It is aptly described by the term "mineral crude."[310]

CXC. Tunnel Claim.

A "tunnel claim" is not a mining claim; it only is a means of exploration and discovery. When a lode or vein is discovered in the tunnel the tunnel owner is called upon to make a location of the ground containing the vein or lode and thus create a mining claim.[311]

CXCI. Tunnel Right.

A grant of a "tunnel right" through a specific piece of ground is a right to enter upon and occupy the ground for the purpose of prosecuting the work in the tunnel, and to extract therefrom waste rock or earth necessary to complete the running of the tunnel, and making such use thereof, after completion, as may be necessary to work the mining ground or lode owned by the party running the tunnel. By implication the grant of such a right carries with it every incident and appurtenant thereto, including the right to dump the waste rock at the mouth of the tunnel on the land owned by the grantor at the time of the conveyance of the tunnel right; such right or easement being necessary for the full and free enjoyment of the tunnel right.[312]

CXCII. Tunnel Sites.

There is no distinction between a tunnel claim under which a tunnel is run for the development of veins or lodes already located, and one pursuant to which a tunnel is projected for blind veins or lodes.[313]

---

[307] Day, *supra*,(58) citing and applying the cases of N. P. R. Co. vs. Soderberg *supra* (72): Castle vs. Womble, 19 L. D. 455: Pacific Coast Co. vs. N. P. R. Co., *supra*.(90) and Cataract Co., 43 L. D. 248, and distinguishing the cases of Zimmerman vs. Brunson, 39 L. D. 340: Stanislaus Co., 41 L. D. 655.

[308] Atherton vs. Fowler, 96 U. S. 513; Nevada Sierra Co. vs. Home Oil Co., *supra* (221); see, also, Campbell vs. Rankin *supra* (157); Haws vs. Victoria Copper Co., *supra*.(205)

[309] Cowell vs. Lammers, *supra* (60); Duffield vs. San Francisco Co., *supra*.(242)

[310] Hempstead & Son vs. Thomas, *supra*.(135)

[311] Creede Co. vs. Uinta Co., *supra* (106); see Primeau vs. Acton, 66 Colo. 603, 185 Pac. 255. The use of a part of the public land for the construction of a tunnel and for buildings to aid in the working of a mine does not initiate any right to such ground as an independent mining claim. Waterloo Co. vs. Doe, *supra*.(120)

[312] Scheel vs. Alhambra Co., 79 Fed. 821; Himrod vs. Ft. Pitts Co., *supra* (202); see, also, Sparks vs. Hess, 15 Cal. 196; Cave vs. Crafts, 53 Cal. 138; Farmer vs. Water Co., 56 Cal. 13; Smith vs. Cooley, *supra* (264); Jackson vs. Trullinger, 9 Or. 398.

[313] Adams, 42 L. D. 457. A tunnel driven for the development of veins or lodes can be credited as an improvement common thereto, whether the purpose is to claim any blind veins or lodes on the line of the tunnel or not. Dawson, 40 L. D. 20. Work done in such a tunnel may be counted as annual assessment work. Hain vs. Mattes, 34 Colo. 345, 83 Pac. 127, *compare* Royston vs. Miller 76 Fed. 50

CXCIII. Unavoidable Casualties.

The term "unavoidable casualties" means that which could not be avoided by the exercise of reasonable diligence and skill.[314]

CXCIV. Unoccupied and Unappropriated Land.

The term "unoccupied" and "unappropriated" refer to land that is not in the possession of one who claims the right of possession thereto by virtue of a compliance with the law.[315]

CXCV. Usual Mining Privileges.

By the term "usual mining privileges" in a deed the grantee has and may enjoy the right to go upon the land and explore for, open and operate mines, take out and sell the product, and do all things incident to that work.[316]

CXCVI. Vacant Land.

Land is not "vacant" when occupied as a mining claim without discovery by one who is diligently prospecting it for minerals which it may contain.[317]

CXCVII. Veins and Lodes.

The fact that the terms "veins" and "lodes" have been used by congress in connection with each other is suggestive that it was intended to avoid any limitation in the application of the mining acts which might be imposed by a scientific definition of either term.[318]

CXCVIII. Wash.

The term "wash" belongs neither to the terminology of geology nor of law. The wash of a stream is the sandy, rocky, gravelly, boulder-bestrewn part of a river bottom. The "cone" of the stream is not synonymous with "wash" of the stream; nor conterminous with it.[319]

CXCIX. Water Rights.

When one has legally acquired a "water right," he has a property right therein that can not be taken from him for public or private use except by due process of law and upon just compensation being paid therefor. One who has acquired a legal water right can only be deprived of it by his voluntary act in conveying it to another, by abandonment, forfeiture under some statute, or by operation of law. A "water right" is an independent right and is not a servitude upon some other thing, and is an incorporeal hereditament, being neither tangible nor visible.[320]

CC. Waste.

"Waste," is the doing of those acts which cause lasting damage to the freehold or inheritance or the neglect or omission to do those acts which are required to prevent lasting damage to the freehold or inheritance. The term is not an arbitrary one, however, to be applied inflexibly, without regard to the quality of the estate or the relation to it of the person charged to have committed the wrong, but the question as to whether it has been committed in a given case is to be determined in view of the particular facts and circumstances appearing in that case.[321]

---

[314] Bennett vs. Howard, 175 Ky. 797, 195 S. W. 118.

[315] Conn vs. Oberto, 32 Colo. 313, 76 Pac. 369. Every competent locator has the right to initiate a lawful claim to unappropriated public land by a peaceable adverse entry upon it while it is in the possession of those who have no superior right to acquire the title or to hold the possession. Any other rule would make the wrongful occupation of public land by a trespasser superior in right to a lawful entry of it under the acts of congress by a competent locator. Thallman vs Thomas, *supra* (221); Malone vs. Jackson, *supra* (221); see, also, Nevada Sierra Co. vs. Home Oil Co., *supra* (221); Miller vs Chrisman, *supra.*(58)

[316] Imperial Co. vs. Webb, 190 Ky. 41, 225 S. W. 1076.

[317] Cosmos Co. vs. Grey Eagle Co., *supra*,(241) 112 Fed. 4, 190 U. S. 301; McLemore vs. Express Co., *supra.*(37)

[318] Hayes vs. Lavagnino, 17 Utah 196, 53 Pac. 1029. By the term "veins or lodes" as used in the mining statutes is meant lines or aggregations of minerals embedded in quartz or other rock in place. U. S. vs. Ohio Oil Co., 240 Fed. 1000.

[319] Haack vs. San Fernando Co., 177 Cal. 140, 169 Pac. 1021.

[320] Bennett vs. Twin Falls Co., 27 Ida. 643, 150 Pac. 339.

CCI. Who Are and Who Are Not Co-owners.

Tenants in common are "co-owners" of the substance of the estate. They may make such reasonable use of the common property as is necessary to enjoy the benefit and value of such ownership. Since an estate of a "co-owner" in a mine or oil well can only be enjoyed by removing the product thereof, the taking of mineral from a mine and the extraction of oil from an oil well are the use and not the destruction of the estate.[321a]

A person having merely an inchoate title, such as the holder of a sheriff's certificate of purchase, is not a "co-owner."[322] A stockholder who has no title separate and distinct from that of the corporation which is the owner of a mining claim is in no sense a "co-owner" with the corporation nor with the other shareholders of such corporation.[323]

CCII. Withdrawals.

1. "Withdrawals" are a law made, a joint resolution passed by Congress, a proclamation made by the President, or an order issued by officers of the Land Department, or other proper officer.

Thereby public lands are withdrawn from location, sale and entry under the laws affecting the public domain. They sometimes are made in recognition of what is about to occur and sometimes in recognition of what has occurred.[324] A withdrawal by proclamation of the President takes effect from its date. An executive withdrawal operates from the time it is made or when received at the local land-office, as its terms may dictate.[325]

2. Mineral Rights. Under the Withdrawal Act of June 25, 1910,[326] a homestead entry on withdrawn lands secures no right to the oil below the surface, nor the right to prospect therefor. These rights are reserved to the United States.[327]

3. Restored Lands. Under the provisions of the act of September 30, 1913, public lands which have been excluded from national forests

---

[321] Chapman vs. Cooney, 25 R. I. 657, 57 Atl. 929. As was said in McCord vs. Oakland Co., 64 Cal. 140, 127 Pac. 863: "The law on this subject must be applied with reasonable regard to the circumstances."

[321a] Prairie Co. vs. Allen, 2 Fed. (2d) 566 and cases cited. But see Zeigler vs. Brenneman, 230 Ill. 15, 86 N. E. 597; Gulf Ref. Co. vs. Carroll, 145 La. 299, 82 So. 597; South Penn Co. vs. Haught, 71 W. Va. 720, 78 S. E. 759.

[322] Repeater Claims, 35 L. D. 56; see Turner vs. Sawyer, 150 U. S. 578.

[323] Repeater Claims, *supra* (322); Yard, 38 L. D. 68.

[324] See 5 U. S. Comp. St., pp. 2320, 2321, 2322. §§ 4523, 4524, 4526; U. S. vs. Midwest Co., 236 U. S. 459, rev'g. 206 Fed. 141; U. S. vs. Ohio Co., *supra* (318); U. S. vs. Stockton Oil Co., 240 Fed. 1006; U. S. vs. North American Co., 242 Fed. 723; U. S. vs. Thirty-Two Oil Co., 242 Fed. 730; U. S. vs. Record Oil Co., *supra* (163); U. S. vs. Caribou Oil Co., 242 Fed. 746; Con. Mutual Oil Co. vs. U. S., *supra* (49); For a collation of cases see, 48 L. D. 97; see, also, Id. 172; and see Wood vs. Beach, 156 U. S. 648; U. S. vs. Hodges, 218 Fed. 87; Knudsen vs. Omanson, 10 Utah 124, 37 Pac. 250; see, also, U. S. vs. McCutchen, 217 Fed. 650; Johnson, (on rehearing) 48 L. D. 18.

[325] Smith, 33 L. D. 677; N. P. R. Co. vs. Pettit, 14 L. D. 591; U. P. R. Co. vs. Peterson, 28 L. D. 32.

Under the Act of June 30, 1919, no lands may now be withdrawn or Indian Reservation established except by Act of Congress, 2 Supp., U. S. Comp. St., p. 1358, § 4529*b*.

[326] 5 U. S. Comp. St., p. 5320, § 4523.

[327] Son vs. Adamson, 188 Cal. 99; 204 Pac. 392.

or released from withdrawals may be disposed of by such methods as the President may provide.[328]

CCIII. Working a Claim.

To "work" a mining claim is to do something toward making it productive, such as developing or extracting an ore body after it is discovered.[329]

CCIV. Workmen's Compensation Acts.

The object of workmen's compensation laws is to substitute for the imperfect and economic wasteful common-law system by private action by an injured employee for damages for negligence on the part of the employer, a system by which every employee in a hazardous industry might receive compensation for any injury suffered by him arising out of and in the course of the employment. Under the common-law action the injured employee could only recover by proof of negligence on the part of the employer and by proof of freedom from contributory negligence on his own part. Under workmen's compensation laws it is not necessary to prove either negligence on the part of the employer nor freedom from negligence on the part of an injured employee. The theory of such legislation is the loss occasioned by reason of injury to employees shall not be borne by the employees alone, as under the common-law system, but directly by the injury itself and indirectly by the public. This class of legislation has been formulated after the most patient study and investigation by the most eminent men in professional and industrial walks of life in order to avoid any obstructions or limitations as might be encountered under the written constitution, as such laws now in force in a great number of the states have in almost every instance been held constitutional.[330]

CCV. Zone.

A metal zone is equivalent to a mineral zone yet the terms "mineral" and "metal" are not synonymous.[331]

---

[328] 5 U. S. Comp. St., p. 5322, § 4528. For opening of lands restored by the Secretary of the Interior after withdrawal, see Id. § 4529, 40 L. D. 656; Donley vs. West, 31 Cal. A. 937; 189 Pac. 1052.

[329] Cole vs. Ralph, *supra* (7); see Bailey vs. Bond, 77 Fed. 406; Mt. Diablo Co. vs. Callison, 17 Fed. Cas. 9886.

[330] Shea vs. North-Butte Co., 55 Mont. 522, 179 Pac. 501; see Arizona Copper Co. vs. Hammer, 250 U. S. 400; Cudahy P. Co. vs. Parramore, 263 U. S. 418.

For a case involving scope of employment and the right to compensation, see Atolia Co. vs. Industrial Accident Com., *supra*.(152)

[331] Mt. Diablo Co. vs. Callison, *supra* (329); see N. P. R. Co. vs. Soderberg, 99 Fed. 9886. A belt or zone, in order to constitute a lode, must bear some of the minerals or valuable deposits mentioned in the statute. Meydenbauer vs. Stevens, *supra*.(152)

"Kidneys" is a term applied by miners to a mineral zone which narrows down until very thin and then suddenly expands and again suddenly contracts. Meydenbauer vs. Stevens, 78 Fed. 791; Rough Rider, *supra*.(277)

ADMINISTRATIVE DIVISION.

Walter W. Bradley, Deputy State Mineralogist.

Personnel.

During the period, October 15-January 15, the following changes in personnel have taken place:

Mr. Forest L. Campbell has returned to the post of Librarian of the Bureau, after an absence of several months as an inspector in the oil division.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Bulletin No. 94, "California Mineral Production for 1923," by Walter W. Bradley. For free distribution.

Mining in California (quarterly), October, 1924, being Chapter No. 4 of State Mineralogist's Report XX. Price 25 cents (or $1.00 for the year).

Summary of Operations—California Oil Fields, Vol. 10, Nos. 1, 2 and 3, July, August and September, 1924, respectively.

Commercial Mineral Notes: Nos. 19, 20, 21, October-December (inclusive). These "notes" carry the lists of "mineral deposits wanted" and "minerals for sale," issued in the form of a mimeographed sheet, monthly. It is mailed free of charge to those on the mailing list for "Mining in California."

Mails and Files.

The Bureau maintains, in addition to its correspondence file, a mine report file which includes reports on some 7500 mines and mineral properties in California. Also there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the period covered by this quarterly report, there were 1771 letters received and answered at the San Francisco office alone, covering almost every conceivable phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

Walter W. Bradley, Deputy State Mineralogist.

STATISTICS.

Estimate of 1924 Output.

California Mineral Production in 1924, a New High Record.

The total value of the mineral production of California for the year 1924, just closed, is conservatively estimated to have been approximately $358,745,000. This is, in part, detailed in the tabulation below; but, as there are fifty mineral substances on California's commercial list, it is impracticable at this early date to obtain anything approaching definite figures on other than the more important items. The blank report forms are being mailed out to the operators in all mineral lines, and the date of publication of the final and complete report will depend upon the promptness of their replies.

This estimated total of $358,745,000 is an increase of nearly $15,000,000 over the 1923 production, which in turn surpassed the previous record value of the year 1921. This increase in value is due in part to petroleum which, although decreasing some 33,000,000 barrels in quantity, it is estimated will show an advance in total value for the year because of the higher prices per barrel prevailing during 1924. The greatest declines in quantity were in the Santa Fe Springs, Huntington Beach and Long Beach fields, following the flush period; but this was partly offset by the development of new fields and the resumption of closed-in production in some of the older fields.

Though reports from a number of the gold mining districts have been indicative of renewed interest and renewing operations, receipts of bullion at the mint and smelters show a decrease for the year, due to lessened output from the dredges. Smelter reports give increased quantities for copper but less lead and silver. Zinc again appears after an absence in 1923.

As the demand for building materials continued active during 1924, nearly all items of the structural group will show increased quantities and total values, especially cement, brick, hollow building tile, crushed rock, sand and gravel. Magnesite shipments decreased about 15 per cent in quantity, and the market price dropped off somewhat, owing to increased imports from India. The demand for this material for stucco and other plastic purposes is showing a healthy growth. There were no notable changes in the general status of the miscellaneous 'industrial' group, nor among the salines. Demand for achitectural terra cotta and tile has caused increased shipments of pottery clays of all grades. Preliminary reports indicate that most of the salines group will show increases for 1924.

The estimated quantities and values for 1924 are tabulated as follows:

$12,975,000	gold.
2,225,000	(3,338,000 fine oz.) silver.
6,879,000	(53,330,000 lb.) copper.
413,000	(5,162,000 lb.) lead.
149,000	(2,380,000 lb.) zinc.
30,000	iron and manganese ores.
550,000	(8,100 flasks) quicksilver.
50,000	(400 fine oz.) platinum.
250,000,000	(230,000,000 bbl.) petroleum.
16,250,000	(250,000,000 M. cu. ft.) natural gas.
28,320,000	(11,800,000 bbl.) cement.
17,000,000	crushed rock, sand and gravel.
10,200,000	brick and hollow building tile.
704,000	(64,000 tons) magnesite.
2,000,000	other structural materials, including granite, lime, marble, et al.
6,000,000	miscellaneous 'industrial' minerals (including asbestos, barytes, pottery clays, dolomite, feldspar, gems, graphite, diatomaceous earth, limestone, lithia, mineral water, shale oil, silica, talc, et al.).
5,000,000	salines (including borates, calcium and magnesium chlorides, potash, salt, soda).
$358,745,000	Total value.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors, as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

FRANK L. SANBORN, Mineral Technologist.

There is still an active demand for good radio crystal detectors, and undoubtedly there are many deposits of galena or other minerals in this state that could be utilized for this purpose. The most popular minerals used as crystal rectifiers are galena and pyrite. Other minerals are used, however, among them being zincite, bornite, chalcopyrite, molybdenite, octahedrite, brookite and argentite.

The best crystal detectors so far received at the laboratory of the State Mining Bureau came from Inyo County, and as but few samples of possible detectors have been received since facilities for testing them have been installed in this laboratory, it is possible that future testing of crystals will prove the existence of other good deposits of mineral suitable for this work.

Evidently much interest is being taken throughout the state in the prospecting for minerals in general, for the number of samples now received at the bureau each month is greater than at any time since the bureau was organized over forty years ago. During the past four months 1535 samples were received and determined.

Samples of clay have recently been the most frequent mineral received for identification.

California has extensive and varied clay deposits, but published information regarding the California clays is meager. There are many different kinds of clays in this state and uses will probably be found for many of these silicates. In addition to the ceramic industries, clays are used for many purposes, but ordinarily chemical analysis is of little value in determining the best use to which a clay is suited.

Fuller's earth is a variety of clay which has the power of absorbing greasy substances. It is difficult to distinguish this material from ordinary clay. A quantitative analysis shows that it possesses a higher percentage of combined water than ordinary clay. A physical test is the best method of identifying fuller's earth.

LIBRARY.

FOREST L. CAMPBELL, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

- Prof. Paper No. 132-H—The Resuscitation of the Term Bryn Mawr Gravel. By F. Bascom.
- Prof. Paper No. 132-G—Discovery of a Balkan Fresh-Water Fauna in the Idaho Formation of Snake River Valley, Idaho. By W. H. Dall.
- Prof. Paper No. 132-F—Relations of the Wasatch and Green River Formations in Northwestern Colorado and Southern Wyoming. By J. D. Sears.
- Prof. Paper No. 134—Upper Cretaceous and Tertiary Formations of the Western Part of the San Juan Basin, Colorado and New Mexico. By J. B. Reeside.
- Prof. Paper No. 135—The Composition of the River and Lake Waters of the United States. By F. W. Clarke.
- Bulletin No. 756—Oil and Gas Fields of Lost Soldier-Ferries District, Wyoming.
- Bulletin No. 751-C—Geology and Possible Oil and Gas Resources South of Bear Paw Mountains, Montana.
- Bulletin No. 750-E—Deposits of Magnesia Alum near Fallon, Nevada. By D. F. Hewitt.
- Bulletin No. 750-F—Molybdenite in the Rocky Bar District, Idaho. By F. C. Schrader.
- Bulletin No. 751-D—Geologic Structure of San Juan Canon and Adjacent Country, Utah. By H. P. Miser.
- Bulletin No. 762—Geology and Ore Deposits of the Rochester District, Nevada. By A. Knopf.
- Bulletin No. 751-E—The Scobey Lignite Field Valley, Daniels and Sheridan Counties, Montana. By A. J. Collier.
- Bulletin No. 751-G—Geology and Oil and Gas Prospects of Part of Moffat County, Colorado, and Southern Sweetwater County, Wyoming. By J. D. Sears.

Bulletin No. 753—Geology and Oil Resources of a Part of Los Angeles and Ventura Counties, California. By Wm. S. W. Kew.
Bulletin No. 765—Geology of the Region Around Lead, South Dakota. By Sidney Paige.
Water Supply Paper No. 521—Part I. North Atlantic Slope Drainage Basins.
Water Supply Paper No. 517. Great Salt Lake Basin.
Water Supply Paper No. 514. Surface Water Supply of the United States. Part XII—North Pacific Slope Drainage Basins.
Water Supply Paper No. 525. Hudson Bay and Upper Mississippi River Basins. By N. C. Grover.
Water Supply Paper No. 520-D. Base Exchange in Ground Water by Silicates as Illustrated in Montana. By B. C. Renick.
Water Supply Paper No. 532. Part XII—North Pacific Slope Drainage Basins. A—Pacific Basins in Washington and Upper Columbia River Basins.
Water Supply Paper No. 513-B. Snake River Basin.

Mineral Resources of the United States:
Copper in 1923.
Lime in 1923.
Feldspar in 1923.
Phosphate Rock in 1923.
Talc and Soapstone in 1923.
Lead in 1923.
Magnanese and Manganiferous Ores in 1923.
Mineral Waters in 1923.
Lead and Zinc Pigments and Salts in 1923.
Arsenic in 1923.
Sand and Gravel in 1923.
Salt, Bromine and Calcium Chloride in 1923.
Asphalt and Related Bitumens in 1923.
Chromite in 1923.
Rare Metals in 1923.
Silica in 1923.
Potash in 1923.
Silver, Copper, Lead and Zinc in the Central States in 1923.
Quicksilver in 1923.
Tin in 1923.
Fuel Briquetts in 1923.
Slate in 1923.
Gypsum in 1923.
Carbon Black from Natural Gas in 1923.
Peat in 1923.
Secondary Metals in 1923.
Stone in 1923.
Coal in 1922.
Zinc, Copper, Lead and Silver in 1923.
Bismuth, Selenium and Tellurium in 1923.
Graphite in 1923.
Fullers Earth in 1923.
Barytes and Barium in 1923.
Zinc in 1923.
Clay in 1923.

Fifty-first Annual Report of the Director, to the Secretary of the Interior for the Fiscal Year ended June 30, 1924.

U. S. Bureau of Mines:
Bulletin No. 228—Estimation of Underground Oil Reserves by Oil Well Production Curves. By W. W. Cutler.
Bulletin No. 227—Flame Safety Lamps.
Bulletin No. 241—Coal Mine Fatalities in the United States, 1923.

Reports of Investigations:
Serial No. 2634—Magnetic Recovery of Combustible in Boiler Plant Refuse. By Rudolf Kudlich.
Serial No. 2635—Explosives used in July, 1924. By W. W. Adams.

Serial No. 2636—Tenth Semi-Annual Motor Gasoline Survey. By N. F. Lejune and B. A. Landry.
Serial No. 2637—Some Features of Ventilating Fans at 164 Coal and Metal Mines. By D. Harrington and M. W. von Bernewitz.
Serial No. 2638—The Critical Time of Day for Coal Mine Explosions. By L. D. Tracy and M. W. von Bernewitz.
Serial No. 2639—Improvement of the Geophone by the use of Electrical Sound Amplifiers. By Walter T. Ackley, Jr., and Clifton M. Ralph.
Serial No. 2640—(Withdrawn.)
Serial No. 2641—Mine Accident Statistics. By W. W. Adams.
Serial No. 2642—Coal Mine Fatalities in August, 1924. By W. W. Adams (Statistician, Bureau of Mines.)
Serial No. 2643—Explosives used in August, 1924. By W. W. Adams.
Serial No. 2644—Additions, Removals and Changes in Permissible List of Explosives from January 1, 1924, to September 30, 1924. By J. E. Crawshaw.
Serial No. 2645—Revised List of Publications on Ceramic Investigations, Bureau of Mines. By L. E. Geyer.
Serial No 2646—Special Sands. By W. M. Weigel.
Serial No. 2647—The Resistance of Coal Mine Entries to the Flow of Air. By J. W. Paul, H. P. Greenwald and G. E. McElroy.
Serial No. 2648—Calcined Dolomite as a Substitute for Lime in the Recovery of Gold and Silver by the Cyanide Process. By E. S. Leaver, C. W. Davis and J. A. Woolf.
Serial No. 2649—Explosion Hazards Incidental to Unwatering Coal Mines. By L. D. Tracy.
Serial No. 2650—Coal Mine Fatalities in September, 1924. By W. W. Adams.
Serial No. 2651—Factors Retarding Transmission of Radio Signals Underground, and Some Further Experiments and Conclusions. By J. J. Jakosky and D. H. Zellers.
Serial No. 2652—Zinc Used for Roofing. By Chas. E. van Barneveld.
Serial No. 2653—Explosives Used in September, 1924. By W. W. Adams.
Serial No. 2654—Effects of Temperature and Pressure on Gypsum and Anhydrite. By Marie Farnsworth.
Serial No. 2655—The Analysis of Oil Wax Mixtures. By L. D. Wyant and L. G. Marsh.
Serial No. 2656—The Production of Sponge Iron. By Clyde E. Williams, Edward P. Barrett, and Bernard M. Larsen.
Serial No. 2657—Coal Mine Fatalities in October, 1924. By W. W. Adams.
Miners Circular No. 28—Sanitation in Mines. By R. R. Sayers.
Technical Paper No. 336—Oxidation of Zinc Vapor by Carbon Dioxide. By B. M. O'Harra.
Annual Report of the Director to the Secretary of the Interior for the Fiscal Year ended June 30, 1924.

Queensland, Royal Society of:
Proceedings for 1923, Vol. XXXV.

Victoria, Geological Survey of:
Maps:
Jumbuk.
Mardan.
Bulga
Koorooman
Callignee.

Western Australia Geological Survey:
Bulletin No. 89—The Geology and Mineral Industry of Western Australia. By A. G. Maitland.

New Zealand. Geological Survey of:
Bulletin No. 26—The Geology and Mines of the Waihi District, Hauaki Goldfield, New Zealand. By P. G. Morgan.

New South Wales. Department of Mines:
Annual Report, 1923.

Scotland, Geological Survey of:
Memoirs. Tertiary and Post-Tertiary Geology of Mull.
Economic Geology of Central Coalfield of Scotland.

- England, Ordinance Survey of:
  - Maps:
    - Hertford.
    - Wem (Drift).
    - Wem (Solid).
- Great Britain, Geological Survey of:
  - The Geology of the Country Around Dartford. By Henry Dewey.
  - The Geology of the Country Around Hertford. By R. L. Sherlock.
  - Summary of Progress for 1923.
  - Geology of Flint, Hawarden, Etc., 1924.
  - Geology of Brighton and Worthing, 1924.
  - Special Mineral Reports, 1924.
- Warsaw, Polish Ministry of Foreign Offairs:
  - Production of Coal, Lignite, Coke and Coal Briquettes for the Month of June, 1924.
  - Production of Petroleum, Natural Gas and Mineral Wax for the Months of May and June, 1924.
  - Production of Salt and Potassium Salts for the Month of June, 1924.
- U. S. Army:
  - Annual Report of the Chief of Engineers for 1924.
- Federal Power Commission:
  - Four Annual Report, 1924.
- Smithsonian Institution:
  - Proceedings of the U. S. National Museum, Vol 63.
- U. S. Treasury Department:
  - Annual (1924) Report of the Director of the Mint.
- U. S. Coast and Geodetic Survey:
  - Earth Movements in California. By William Bowie.
  - Geodetic Operations, January 1, 1922—December 31, 1923.
    - Annual Report of the Director to the Secretary of Commerce for the Fiscal Year ended June 30, 1924.
- Librarian of Congress:
  - Report for the Fiscal Year Ended June 30, 1924.
- Alabama, Geological Survey of:
  - Bulletin No. 27—Statistics of the Mineral Production of Alabama for 1922. By W. S. Ernst.
  - Museum Paper No. 7—The Genus Gyrotoma. By C. Goodrich.
- Illinois, State Geological Survey:
  - Prospects for Oil in Decatur Area, Illinois.
- Kentucky Geological Survey:
  - The Road Materials of Kentucky. By C. H. Richardson.
  - A Bibliography of the Several Books, Reports and Maps Principally Relating to Geology.
  - Kentucky State Parks, 1924.
- North Carolina Geological and Economic Survey:
  - Some Facts and Figures About North Carolina and Her Natural Resources.
- Pennsylvania Geological Survey:
  - Bituminous Coal Losses and Mining Methods in Pennsylvania. By J. D. Sisler.
  - Bulletin No. M3—Lead and Zinc Ores of Pennsylvania. By B. L. Miller.
  - Bulletin No. M5—The Silicia Refractories of Pennsylvania. By E. S. Moore.
- Washington, Department of Conservation and Development:
  - Bulletin No. 30—Mineral Resources of Washington with Statistics for 1922.
  - Bulletin No. 29—Coal Fields of Skagit County, Washington.
- Canada, Department of Mines:
  - Bentonite. By H. S. Spence.
  - Development of Chemical Metallurgical and Allied Industries in Canada in Relation to the Mineral Industry. By A. W. Wilson.
  - Thirty-second Annual Report of the Ontario Department of Mines.
  - The Mining Laws of Canada.
  - Bulletin No. 625—Bituminous Sands of Northern Alberta. By Sidney C. Ellis.
  - Canadian Arctic Expedition, 1913-1918.
  - Memoir 139—Coginhalla Area, British Columbia.
  - Report on Ontario Iron Ores, 1923.

Thirty-first Annual Report and Maps, Ontario Department of Mines, Vol. 31, Part II, 1922.

Canada, The Dominion Fuel Board:
  Central and District Heating Possibilities of Application in Canada. By F. A. Combe.

Transvaal Chamber of Mines:
  Thirty-fourth Report, 1923.

Montevideo, Instituto de Geologia y Perferaciones:
  Boletin No. 6, June, 1924.

Archivos do Museu Nacional do Rio de Janiero. Vol XXIV.

Boletin do Museu Nacional do Rio de Janiero. March, 1924.

Deputy Master and Comptroller of the Royal Mint:
  Fifty-fourth Annual Report, 1923.

Queensland Geological Survey:
  Publication No. 273—Mesozoic Insects of Queensland. By R. J. Tillyard.

Societies and Educational Institutions.

University of California:
  Pelecypoda from the Marine Oligocene of Western North America. By B. L. Clark.

Pennsylvania State College:
  Bulletin No. 32—Heat Transmission and Efficiency in Steam Boiler Tubes. By E. A. Fessenden.
  Bulletin No. 31—A New Application of the Induction Motor in Signalling Devices. By P. X. Rice.

American Institute of Mining and Metallurgical Engineers:
  Transactions. Vol. LXX.

Peru:
  Boletin del Cuerpo de Ingenieros de Minas del Peru. No. 107.

Books.

The Mineral Industry, 1923, Vol. 32.
The Mines Handbook, 1925.

Maps.

U. S. Geological Survey Topographic Sheets:
  Alto Pass, Ill.-Mo.
  Barre, Vt.
  Braymer, Mo.
  Dinuba, Calif.
  Frankfort, Ky.
  Kankakee, Ill.
  Lebanon, Oregon.
  Momence, Ill.-Ind.
  Oregon, Ill.
  Spruce Knob, W. Va.-Va.
  Tranquillity, Cal.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Bulletin, Union Oil Co., Los Angeles.
California Journal of Development, San Francisco.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical Engineering and Mining Review, London, England.
Engineering and Mining Journal-Press, New York.
Explosives Engineer, Wilmington, Del.
Financial Insurance News, Los Angeles, California.
Graphite, Jersey City.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mine and Quarry, Chicago.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.

Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil and Gas News, Kansas City.
Oil News, Galesburg, Illinois.
Oildom, New York.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, Sacramento, Cal., and Unionville, Nev.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of Mining in California was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of Mining in California, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

31-1 Anything connected with mining.

31-2 Assessment work to do on contract. Thorough placer and quartz mining man.

31-3 Assayer and chemist. Nine years' experience, cement, copper, and commercial laboratory. Age 29. Single. Reference.

31-4 Mill man or general superintendent. Thirty years' general experience in operation of mines and mills. Age 55. Married. References. Minimum salary, $200.

31-5 Mining engineer. Over ten years' general experience in operation and examination of mines in the United States, Mexico and South America. Can do surveying and assaying. Age 43. References. Salary open; reasonable.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; Pacific Finance Building, Los Angeles; in Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. By Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916, Fletcher Hamilton:	
Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	.65
Same, including geological map of Inyo County	1.25
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper	.50
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper	.50
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65
Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
A general Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	3.75
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75

REPORTS—Concluded.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924. per copy	$0.25
Chapters of Twenty-first Report of State Mineralogist, Mining in California. Lloyd L. Root. Published quarterly. January, 1925	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, 1924	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæntology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps	$0.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæntology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps	----
Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kuntz. 1905, 168 pp., 54 illustrations	.25
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted	2.50

BULLETINS—Concluded.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring, 1918. 248 pp., 51 illustrations, 5 maps, paper	$0.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California. (In preparation.)	------
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916–1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917–1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	.50
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	1.25
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth	1.00
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley, 1923	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley, 1924	Free

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	----

PRELIMINARY REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free
Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper	Free
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----
**Register of Mines, with Map, San Diego County	----
**Register of Mines, with Map, Santa Barbara County	---

MAPS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
**Register of Mines, with Map, Yuba County	----
Register of Oil Wells, with Map, Los Angeles City	----

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California, Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted	$0.50
**Unmounted	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
Map of Plumas County	.25
**Map of Trinity County	----
Map of Tuolumne County	.25
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County	.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emido and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75

OIL FIELD MAPS—Continued.

Map No. 13—Kern River, Kern County	$0.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	1.00
Map No. 30—Rosecrans, Los Angeles County	1.00

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

37083 5-25 2650

THE STATE MINING BUREAU

CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE

MINERAL RESOURCES OF CALIFORNIA

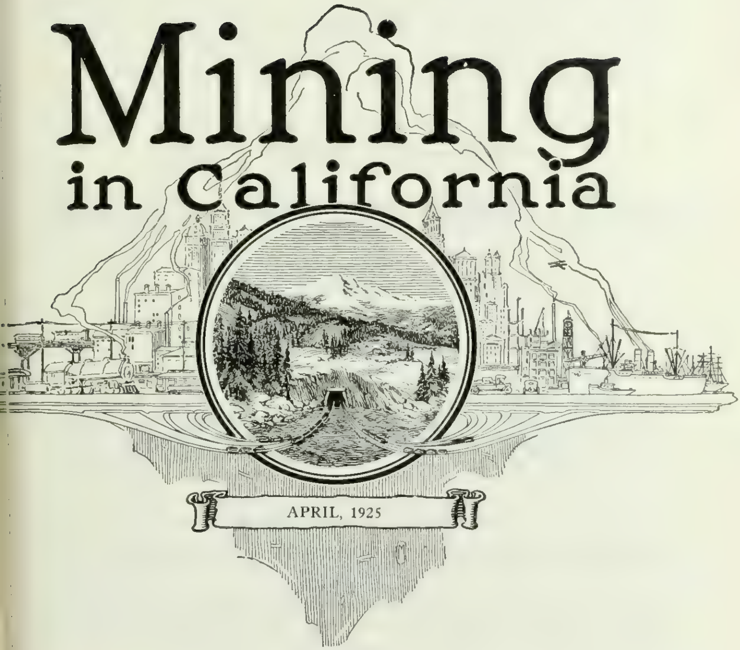
At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the State Mineralogist, as well as that of his technical staff, is also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily.
Saturday, 9 a.m. to 12 m.

LLOYD L. ROOT,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.
Branch Offices: Pacific Finance Building, Los Angeles; Chamber of Commerce Building, Sacramento, Bakersfield, Taft, Coalinga. Santa Maria. and Santa Paula.

Mining in California



APRIL, 1925

PUBLISHED QUARTERLY

CALIFORNIA STATE
MINING BUREAU

FERRY BUILDING
SAN FRANCISCO

CALIFORNIA STATE MINING BUREAU.

EXECUTIVE AND TECHNICAL STAFF

LLOYD L. ROOT
State Mineralogist

WALTER W. BRADLEY
Deputy State Mineralogist

MINING DIVISION

C. A. LOGAN, District Mining Engineer	Sacramento
C. McK. LAIZURE, District Mining Engineer	San Francisco
W. BURLING TUCKER, District Mining Engineer	Los Angeles
FRANK SANBORN, Mineral Technologist	San Francisco

DEPARTMENT OF PETROLEUM AND GAS

R. D. BUSH, State Oil and Gas Supervisor	San Francisco

NOTE.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT State Mineralogist

Vol. 21 APRIL, 1925 No. 2

CHAPTER OF

REPORT XXI OF THE STATE MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

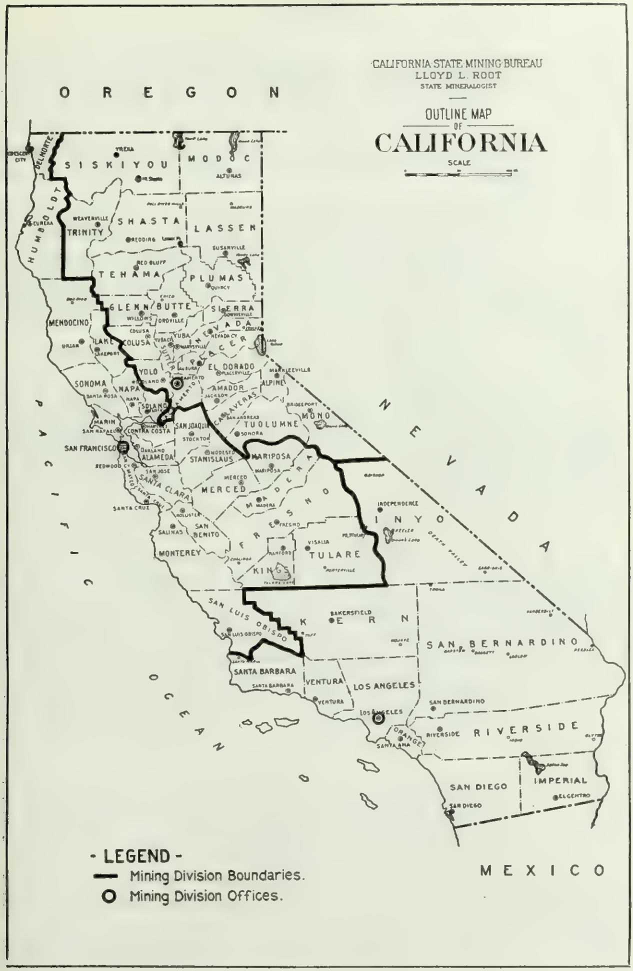
ACTIVITIES OF THE STATE MINING BUREAU

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1925

CONTENTS.

Page

DISTRICT REPORTS OF MINING ENGINEERS 135
  Sacramento Field Division 135
  San Francisco Field Division 173
  Los Angeles Field Division 223
  Oil Field Development Operations 246
SPECIAL ARTICLES 251
  California Foundry Sands 251
ADMINISTRATION DIVISION 258
DIVISION OF MINERALS AND STATISTICS 259
  Statistics 259
  Museum 266
  Laboratory 266
LIBRARY 267
PRODUCERS AND CONSUMERS 273
EMPLOYMENT SERVICE 274
BUREAU PUBLICATIONS I


CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST
OUTLINE MAP OF CALIFORNIA
SCALE
OREGON
NEVADA
PACIFIC OCEAN
MEXICO
DEL NORTE
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
LAKE
COLUSA
YUBA
NEVADA
SUTTER
PLACER
YOLO
SACRAMENTO
EL DORADO
ALPINE
SONOMA
NAPA
SOLANO
AMADOR
CALAVERAS
MONO
MARIN
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
FRESNO
INYO
SAN BENITO
MONTEREY
KINGS
TULARE
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
YREKA
ALTURAS
EUREKA
WEAVERVILLE
REDDING
SUSANVILLE
RED BLUFF
QUINCY
WILLOWS
OROVILLE
UKIAH
COLUSA
NEVADA CY.
PLACERVILLE
MARKLEEVILLE
SANTA ROSA
NAPA
JACKSON
BRIDGEPORT
SAN ANDREAS
SONORA
SAN RAFAEL
STOCKTON
OAKLAND
MODESTO
MARIPOSA
REDWOOD CY.
SAN JOSE
MERCED
MADERA
INDEPENDENCE
SANTA CRUZ
HOLLISTER
SALINAS
FRESNO
VISALIA
HANFORD
DEATH VALLEY
BAKERSFIELD
SAN LUIS OBISPO
MOJAVE
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
SANTA ANA
SAN DIEGO
EL CENTRO
- LEGEND -
Mining Division Boundaries.
Mining Division Offices.

PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. Therefore, beginning with the January, 1925, issue of 'Mining in California,' the district engineers' reports are in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

CALAVERAS COUNTY.

Geography.

Calaveras County lies on the west slope of the Sierra Nevada Mountains, the elevation ranging from 400 feet above sea level where it joins San Joaquin County on the west, to 8000 feet where the eastern boundary rests on the summits of the Sierras adjoining Alpine. Bounded on the north by Amador County and on the south by Tuolumne, it shares with them the advantage of a climate where snow seldom falls and practically never lies below 2500 feet elevation, and where mining may be carried on throughout the year under ideal weather conditions. The county is drained by Mokelumne, Stanislaus and Calaveras rivers, the branches of the former reaching into the highest mountains.

Timber, Transportation, Power and Water.

The eastern part of the county contains thousands of acres of timber, much of it held by large companies but partly in national forests and not yet tapped by a railroad.

Three railroad branches enter the county—Angels Branch of the Sierra Railway Company of California, extending from Jamestown in Tuolumne County, and connecting with trunk lines at Oakdale; and branches of the Southern Pacific, extending from Lodi to Valley Spring, and from Stockton to Milton. The first named serves the mines of the Melones, Carson Hill, Angels Camp, Murphy, Vallecito and adjoining districts. Freight and supplies for San Andreas, Mokelumne Hill, West Point and other districts come via Valley Spring, and the Milton branch serves the copper and gold mines in the southwestern part of the county. A good automobile highway connects San Andreas, the county seat, with the valley system of concrete state highways, via Valley Spring. A good dirt road passable for automobiles all the year, crosses the county from Jackson to Melones, with branches to all the outlying districts which for the most part are accessible by automobile at all seasons.

Electric power is supplied to all of the principal mining districts, the Angels Camp, Murphy and nearby districts having service from both Utica Mining Company and Pacific Gas and Electric Company; the latter company doing most of the business in the northern part of the county.

The increasing demand for water and the necessity for its conservation have been brought home to the people of the county by the action of the East Bay Utilities district which has taken steps to secure a municipal water supply for the east bay cities partly from Mokelumne River, and the plans of the city of Stockton to put up a flood control dam on Calaveras River west of San Andreas. Litigation is in progress at present between the city of Stockton and some landowners of Calaveras County regarding value of land desired for dam purposes, and the whole question of the final disposition of water supplies is of vast importance to all the people of the county.

Mineral Resources.

While the county's mineral resources are varied, the gold mines have been the principal source of wealth. As shown by the table of mineral production, herewith, the gold mines of the county have a recorded production during the past 44 years of over $54,000,000. Annual gold yield has fallen below one million dollars only twice in the past 32 years, during which time the deep quartz mines have been the chief contributors. In spite of pessimistic predictions and the closing of old mines, those best acquainted with the county can not help being hopeful for the future of mining.

Next to gold, copper has been the principal product with a total output estimated at about $25,000,000, including the production from the copper mines between 1861–69, for which exact figures are not available, but which is estimated at about $10,000,000 based upon incomplete figures for the output of the Union, Keystone and Napoleon mines during that period. The production since 1894 has been worth about $16,000,000.

MINERAL PRODUCTION OF

Year	Gold, value	Silver, value	Copper		Mineral paint (ochre)		Clay	
			Pounds	Value	Tons	Value	Tons	Value
1880	$320,865	$643	(1)	-----	-----	-----	-----	-----
1881	800,000	1,200	-----	-----	-----	-----	-----	-----
1882	670,000	-----	-----	-----	-----	-----	-----	-----
1883	500,000	-----	-----	-----	-----	-----	-----	-----
1884	485,000	-----	-----	-----	-----	-----	-----	-----
1885	527,538	2,558	-----	-----	-----	-----	-----	-----
1886	639,457	4,926	-----	-----	-----	-----	-----	-----
1887	640,417	1,477	-----	-----	-----	-----	-----	-----
1888	580,000	1,500	-----	-----	-----	-----	-----	-----
1889	592,243	1,071	-----	-----	-----	-----	-----	-----
1890	618,821	2,499	-----	-----	-----	-----	-----	-----
1891	738,883	4,860	-----	-----	-----	-----	-----	-----
1892	794,531	24,441	-----	-----	-----	-----	-----	-----
1893	1,669,192	122	-----	-----	-----	-----	-----	-----
1894	2,119,365	5,183	654,866	$64,951	115	$2,530	-----	-----
1895	1,717,916	77	175,895	16,925	-----	-----	-----	-----
1896	1,546,398	500	87,557	8,990	-----	-----	-----	-----
1897	1,439,861	1,745	-----	-----	150	2,400	-----	-----
1898	1,019,023	3,462	18,400	2,052	100	225	-----	-----
1899	1,265,564	9,813	165,484	27,586	-----	-----	-----	-----
1900	1,649,126	80,762	980,934	150,585	400	3,800	-----	-----
1901	2,024,685	44,687	1,701,389	268,000	125	500	-----	-----
1902	2,072,939	46,234	2,087,501	251,062	259	778	-----	-----
1903	1,904,125	68,280	2,246,675	297,263	200	1,000	-----	-----
1904	1,789,184	65,611	2,592,124	414,399	70	385	100	$100
1905	1,836,816	78,859	3,666,810	572,022	379	1,900	40	300
1906	1,644,234	74,099	5,082,320	956,315	-----	-----	50	250
1907	1,097,974	54,420	3,941,883	609,203	-----	-----	-----	-----
1908	1,378,511	62,727	4,804,446	555,704	50	250	25	250
1909	1,440,511	71,418	5,438,908	690,632	-----	-----	100	500
1910	1,147,705	82,866	7,345,321	778,369	-----	-----	30	250
1911	1,112,315	67,032	6,190,153	773,769	-----	-----	50	200
1912	962,145	70,748	6,125,415	1,010,693	-----	-----	4,281	4,431
1913	1,175,208	61,076	5,063,187	784,794	28	190	2,000	4,500
1914	1,336,875	60,442	4,468,998	594,377	-----	-----	280	280
1915	1,391,134	53,298	4,031,149	705,451	(2)	-----	-----	-----
1916	1,356,120	83,643	6,099,509	1,500,479	-----	-----	-----	-----
1917	1,471,442	87,984	7,720,861	2,107,795	(2)	-----	-----	-----
1918	871,263	84,150	6,762,882	1,670,432	-----	-----	-----	-----
1919	1,550,574	35,876	2,049,330	381,175	-----	-----	-----	-----
1920	1,439,745	16,701	2,112,186	388,642	-----	-----	-----	-----
1921	1,495,758	10,232	(2)	-----	-----	-----	-----	-----
1922	1,413,465	11,648	-----	-----	-----	-----	(2)	-----
1923	1,205,784	7,316	1,598,776	235,020	-----	-----	(2)	-----
Totals	$53,452,712	$1,446,186	[2]93,212,959	$15,816,685	[2]1,876	$13,958	[2]6,956	$11,061

---

[1] The Union Mine at Copperopolis was a producer as early as 1861, but there are no detailed, annual figures available for Calaveras County earlier than here shown.

[2] See under 'Unapportioned.'

[3] Includes clay (pottery), copper, gems.

[4] Includes clay (pottery), crystal quartz, lead, platinum.

CALAVERAS COUNTY, 1880-1923.

Mineral water		Limestone		Quartz crystals, value	Miscellaneous and unapportioned		
Gallons	Value	Tons	Value		Amount	Value	Substance
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	$18,000	717 tons	$3,583	Pyrites.
-------	-------	-------	-------	17,500	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	-------	-------	
-------	-------	-------	-------	-------	3,500 bbls. 25 tons	5,500 375	Lime. Chromite.
-------	-------	3,087	$15,430	10,000	20 tons	300	Chromite.
-------	-------	3,994	7,635	-------	40 tons 13.9 ozs.	280 250	Chromite. Platinum.
-------	-------	6,872	16,955	10,000	-------	-------	
-------	-------	14,165	31,446	10,000	-------	-------	
-------	-------	4,590	11,987	-------	-------	$50,075	Unapportioned, 1900-1909.
-------	-------	6,283	16,976	-------	-------	-------	
10,000	$5,000	3,943	11,733	-------	220 lbs.	10	Lead.
7,528	3,764	-------	-------	-------	-------	-------	
11,500	5,500	2,000	1,400	-------	2,500 lbs. 7,006 lbs. -------	25 308 9,900	Graphite. Lead. Other minerals.
15,508	6,517	-------	-------	-------	650 tons 290 tons 30 lbs. 9 ozs.	4,550 2,618 1 294	Chromite. Fuller's earth. Lead. Platinum.
15,343	5,752	-------	-------	-------	163 lbs. ------- -------	8 1,900 4,350	Lead. Miscellaneous stone. Asbestos, fuller's earth, mineral paint, platinum, silica.
18,255	7,025	-------	-------	-------	1,636 tons 7,238 lbs. 54 ozs. ------- -------	12,570 499 2,453 2,503 300	Chromite. Lead. Platinum. Miscellaneous stone. Other minerals.
16,985	7,009	-------	-------	-------	1,613 tons 6,395 lbs. 20 ozs. ------- -------	34,245 550 1,433 2,700 3,992	Chromite. Lead. Platinum. Miscellaneous stone. Clay, fuller's earth, mineral paint, silica, zinc.
10,938	6,069	-------	-------	-------	3,830 tons 10 ozs. ------- -------	159,453 598 420 2,067	Chromite. Platinum. Miscellaneous stone. Asbestos and lead.
4,384	1,034	-------	-------	-------	2,019 lbs. 8 ozs. ------- -------	107 1,076 600 8,116	Lead. Platinum. Miscellaneous stone. Other minerals.
5,120	512	-------	-------	(2)	20 fine ozs. ------- -------	2,002 2,400 30,048	Platinum. Miscellaneous stone. Quartz crystals and lead.
2,809	791	-------	-------	-------	12 fine ozs. ------- -------	876 17,527 17	Platinum. Miscellaneous stone. Copper and lead.
1,914	639	-------	-------	-------	22 fine ozs. ------- -------	2,150 35,590 39,391	Platinum. Stone, miscellaneous. Other minerals.[3]
1,626	569	-------	-------	(2)	------- -------	39,825 9,605	Stone, miscellaneous. Other minerals.[4]
121,910	$50,181	44,934	$119,062	[2]$65,500	-------	$491,435	

Among other minerals which have been produced may be noted silver, produced as a by-product of gold and copper mining; limestone, mineral paint, clay, mineral water, rock crystal, (quartz) chromite and miscellaneous stone.

Geology.

The Neocene shore-line as indicated by the Ione formation, covered the county from Lancha Plana through Valley Spring to Jenny Lind, and southward to Milton. The most westerly of the lode mining districts are the Hog Mountain-Gopher Range copper mining district, where copper ores occur in diabase and allied rocks, near the southwest corner of the county, and the Campo Seco copper district, where similar ores occur in amphibolite schist. In a depression called Salt Spring Valley, between the older crystalline rocks of Gopher Ridge and Bear Mountains, lies a belt of black Mariposa slate with interbedded lenses of amphibolite, with important copper deposits, which conform in strike with the direction of schistosity of the enclosing rocks.

The Mother Lode belt of black Mariposa slate enters the county at Middle Bar, but aside from the Gwin Mine, which had reached a depth of 2850 feet before it was closed several years ago, little deep mining has been done in this district, though numerous quartz mines have been opened to depths of less than 1000 feet. There are many prominent veins in the granodiorite area of Mokelumne Hill, but the main belt passes southeast, a line of fissuring having passed into the amphibolite schist, in which rock were found the deep mines of Angels Camp and Carson Hill. This belt of mines is characterized by 'free milling' ores carrying two to four per cent of auriferous pyrite, with some telluride ores at Carson Hill. Further notes on the geology of this district are given under Carson Hill Gold Mines, herein. The mines near Mokelumne Hill carry galena in addition to pyrite. The geology of these mines is exemplified by the Boston and Easyz Bird Mines, of which descriptions are given in this report. A west belt of gold mines lies west of Copperopolis in the amphibolite schist and black slate. The characteristics of these mines are illustrated by the accompanying reports on the Gold Knoll and Mountain King Mines.

The East Belt is a general name given to the gold-quartz mining districts in the great body of Calaveras (Carboniferous) rocks, lying east of the younger Mother Lode slate and east of the amphibolite schists accompanying the Mariposa slate. The Calaveras rocks are chiefly hard blocky siliceous and micaceous schists, quartzite, curly black slates and accompanying intrusive dikes, usually of basic character, which have had a very important effect on the gold-quartz deposits. The underlying granodiorite and more basic rocks of similar composition have been the sources of the ore-deposits and besides the dikes, this deeper rock is at times exposed over wider areas. One such area is the West Point district, where many small, rich ore shoots have been mined.

As might be expected from ore deposits originating from such a source, and not far removed from it, the ores of the East Belt are more 'base' and more complex in character than those of the Mother Lode, and the increasing complexity may be traced northeast, as one travels toward the center of the granodiorite which forms the core of the Sierra Nevadas. The West Point ores contain pyrite, pyrrhotite, galena, zincblende, marcasite, arsenopyrite, and chalcopyrite, in addition to free gold. The characteristics of East Belt mines are shown herein in greater detail under the descriptions of the Sheep Ranch and Washington mines.

Some geologists have asserted that the ore deposits at West Point are the fillings of joint planes, but many of the veins extend for considerable distances on the strike. However, a tabulation of the length of ore-shoots shows that a large number of them are less than 100 feet long. There has been no development deeper than 900 feet in this district and only prospecting is going on there now.

As regards the geology of the ancient river system, this has been covered in detail in references cited, so need not be mentioned here. It is believed that the notes on industrial mineral deposits cover the geology sufficiently in each case.

*Bibliography of Publications on Geology and Mineral Resources of Calaveras County.

Lode mine descriptions, early operations: Mineral Resources West of the Rocky Mountains, from 1867 to 1875, edited by J. Ross Browne (1867–68) and Rossiter W. Raymond (1869–1875), published by the United States Treasury Dept.

Calif. State Min. Bur., State Mineralogist's Reports VI, VIII, XI, XII.

Areal and structural geology: Calif. State Min. Bur. State Mineralogist's Report X (with map). U. S. Geol. Survey Geologic Folios 3, 5, 11 (reprint) and Geologic Folio 63., U. S. Geol. Survey 14th Report, part II, pp. 441–495.

Later Mining Operations, geology, metallurgy: Calif. State Min. Bur. State Mineralogist's Reports XIV, XVII, XIX, XX; Bull 18.

Placer Mining, Ancient Channels (in addition to above general references) U. S. Geol. Survey Prof. Paper 73., Calif. State Min. Bur. State Mineralogist's Report XII, Calif. State Min. Bur. Bull. 92.

Placer Mining (Dredging, gold and platinum) Calif. State Min. Bur. Bull. 85.

---

* All of the above publications are out of print and unobtainable except the XIVth and later reports of the State Mineralogist but reference copies of the older ones may be consulted at the San Francisco, Sacramento and Los Angeles offices of the State Mining Bureau and at the larger public libraries.

METALS.

COBALT.

The following notes were published in our quarterly, MINING IN CALIFORNIA, for January, 1924, on this subject:

> "During the past two years several samples of cobalt diarsenide (smaltite) with erythrite, have been brought to the attention of the Bureau. These apparently came from a single small prospect, which was visited in November, 1923. It is in the northwest quarter of Sec. 22, T. 4 N., R. 14 E. about a mile by trail from the Murphy-Sheep Ranch road and on top of a ridge at an elevation of over 3000 feet.
>
> "A surface cut 15 feet long and 3 feet deep had been made on a stringer of the ore. This had been only a few inches wide between a mica schist footwall and a quartzite hanging wall, and had pinched out, so far as could be seen, both on the dip and strike. Only a few hundred pounds of ore had been found, but samples indicated it was of good grade. * * * "

After the above notes were written, R. C. Johnson began work on the prospect and sank a shaft to a depth of 70 feet, in the course of which work small bunches and boulders of smaltite with arsenopyrite were encountered. The product, amounting to 3 or 4 tons, was lying on the dump and the property was idle in March, 1925. It is equipped with a small gasoline engine, blower and hoist, and is claimed by John Hauselt.

Casey & Bach Claim. Samples sent to the Bureau from Mokelumne Hill by Bert Hammel were identified as asbolite, or cobalt-bearing wad. A shaft was started on a small bunch of this mineral, mixed with quartz which was 16 inches wide at the surface. It pinched out at a depth of six feet, leaving only a seam less than an inch wide at a depth of 15 feet. John Casey and Carl Bach, both of Mokelumne Hill, are the present owners of the claim, which is one mile east of Mokelumne Hill.

COPPER.

Calaveras County was the earliest copper producing county of consequence in the state but since the price of copper dropped in 1919, the copper mines here have been idle with the exception of the Penn Mining Company's property at Campo Seco, where the smelter was shut down April, 1920, after sixteen years' operation; and the Calaveras Copper Company's mines and smelter at Copperopolis, which resumed production in December, 1922, and are still running; besides which activities we have noted only short-lived efforts to operate a few of the smaller mines, such as the Napoleon and Quail Hill. The small copper mines of the county can only be operated at a profit when copper is bringing a fair price, the present market being too low.

The Bureau has had under way for some time the preparation of a bulletin on the 'Foothill Copper Belt' by Professor C. F. Tolman, Jr., and since the field work for that report was done there has been little new development (except as noted, *post,* and in Mining in California for April, 1924) so that detailed mention will not be made here of idle properties, for descriptions of which reference should be made to Report XIV, pp. 56–64; Report VIII, pp. 151–156; and Bulletin 50, pp. 228–245.

As regards changes in the metallurgy of copper, it may be noted that in 1915 and 1916 experiments with the oil flotation process on a working scale began at the Napoleon and Union Mines (the latter now belonging to Calaveras Copper Company) and were so successful that this method was adopted. The ore at Copperopolis is chalcopyrite, carrying no gold and little silver. At Campo Seco and in the other mines the ores carry gold, silver and zinc in varying amounts, the gold and silver in the concentrate often being worth several dollars a ton, and the zinc content of the ore sometimes going as high as 15%. The amount of iron sulphide in the ore limits the grade of concentrate that can be obtained by oil flotation; at times it is hard to get over 10% copper in the concentrate and at the Calaveras Copper Company's plant the flotation concentrate averages about 18% copper after passing the Oliver filter.

Napoleon Copper Mine, on Hog Mountain, Calaveras County. The oldest commercial copper producer in the state.

Calaveras Copper Company. The property and plant were described by the writer in considerable detail in the quarterly, MINING IN CALIFORNIA, for April, 1924, pp. 76–80, inclusive, where a flow sheet of the concentrating and smelting plants was also shown.

In June, 1924, the new reverberatory furnace was put in operation and the blast furnace has not been in use since. Matte can now be drawn as desired and there are savings from the reduction of dust losses and from doing away with the use of coke. Oil is used for fuel. About 125 tons of charge is handled daily.

In the 12th level from Discovery or Keystone shaft, a new orebody is reported 900 feet south of the shaft. Late in March, 1925, this was opened for a length of 150 feet and width of 18 feet, with the total length unknown. Another ore-shoot originally found in 1915, has been opened for a length of 100 feet on the 600 level of South shaft, and the 800 level is being run to reach it. The main ore-shoot is being developed on the 1450 level of Keystone shaft, and should be about 600 feet long, judging by results on the upper levels.

About 225 tons of ore is being mined and milled daily and an effort is being made to reach capacity (400 tons daily) by June 1925.

GOLD

Gold quartz mining has been the principal source of mineral production in this county but this branch of mining has suffered here more than elsewhere during the past ten years because of high prices of labor and commodities. An analysis of production figures for the past ten years indicates that the gold produced from quartz mines has come mainly from a few large properties.

The Utica Mine at Angels Camp was closed in 1918. Mining at the Melones Mine ceased in November, 1918, and milling was stopped in February, 1919. The Gold Cliff Mine of the Utica Mining Company was closed down in April, 1920. None of these mines had been worked out, but conditions had reached a point where operations at the first two named were not paying a profit under conditions then existing, and while the Gold Cliff was yielding a higher grade ore than the average for the district, and was paying some profit, the company felt that the ore might as well stay in the ground until costs receded.

Had it not been for the reopening of the Morgan Mine in 1919, Calaveras County would have fallen out of the list of leading gold producers.

The following notes are intended to summarize the progress of gold quartz mining in the county during the past six years. The size and character of the quarterly publication does not permit a full report on the mines of the county, as a complete listing of even the patented claims would be beyond the scope of the bulletin, not to mention a discussion of the geology of the various mineral belts, claim maps, and other illustrative details which are desirable. Much of these data have been gathered, and it is hoped that they can be published later. Frequent references have been made to past publications which can be consulted at the Bureau's offices.

GOLD MINES (LODE).

Apex (Ford) Mine. Owners: Mrs. Ann Dower $\frac{1}{3}$, Talton Hawes $\frac{2}{3}$. Under lease and option to Apex Mining Company, Dave Cavagnaro, manager, San Andreas. Prospecting work is continuing at this property, which adjoins the townsite of San Andreas. Work so far has been confined to the upper levels, where considerable new ground has been prospected. The old workings reached a depth of 700 feet.

The company has been greatly encouraged by results of prospecting in new ground during the past year. Work has been extended to the three hundred level.

Bibl: State Mineralogist's Report XIV, p. 79; XX, p. 4.

Bachman Mine. Is in Secs. 10, 11, T. 3 N., R. 12 E.; 7 miles south of San Andreas near San Andreas and Angels Road and contains twenty acres. Owners: Constant Bund, Louis Costa, Antone Costa et al. Under lease and option to Joe King of San Andreas, et al who are prospecting it. There were two old shafts on the property, which were 75 feet and 478 feet deep respectively, on separate veins. Work has been resumed on the property within the past few months and electric power brought in. Joe King of San Andreas is in charge of work, which had reached a depth of 100 feet early in 1925.

Bence Mine. (*Esmeralda Extension* and *Tellurium* claims). Mrs. Minnie Hengen, owner, San Andreas. Comprises two full claims, unpatented, near Esmeralda, in Sec. 34, T. 4 N., R. 13 E. The property has lately been leased with option to J. Hildreth of Los Angeles. Development comprises several hundred feet of adit and a shaft 175 feet deep, all done years ago.

Bluejay Mine. Address Allen H. McCarty, Mokelumne Hill. In SW¼ of Sec. 16, T. 5 N., R. 12 E. near North Fork of Calaveras River. James, George and Melvin Hamby are engaged in prospecting the claim through an adit 1800 feet long, most of which was driven years ago. Encouraging prospects are reported and operations may be expanded. There is an old 10-stamp mill, boarding house and other improvements on the claim.

Black Wonder Mine is 9.2 miles east of West Point. It has been described in the Bureau's bulletin MINING IN CALIFORNIA for January, 1922. A Gibson mill has been in operation in 1924–1925. R. W. Bender operating.

Boston Mine. (Formerly *Esperanza* or *Boston Cons.*) Owner: Boston Cons. Mines Co., 154 Sutter Street, San Francisco, care of S. L. Dairdson. Morning Star Mining Company lessee with option to purchase. Main office 244 Kearny Street, San Francisco. S. C. Tomsky, president and Theodore H. Segall, secretary. Mine superintendent, C. H. Page, Mokelumne Hill. Property is two and a half miles from Mokelumne Hill in Sec. 5, T. 5 N., R. 12 E. comprising Esperanza, Royder Placer and Mammoth patented claims and six other unpatended claims, 183 acres in all.

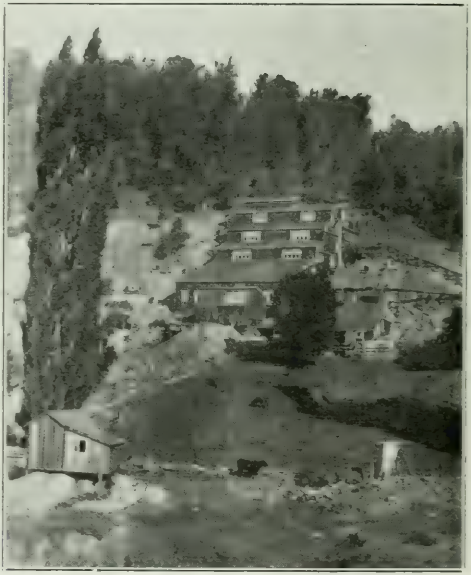
The property was worked in the '80's or earlier and had a 20-stamp mill in 1892, working surface ore. The shaft was sunk between 1893 and 1900, but the mine was idle from 1900 until 1912 when the mill burned down. The new mill was completed in July, 1920, and operations have been intermittent since.

The vein strikes north and dips 30° to 40° east, with a maximum width of 50 feet. It has been developed by a shaft 1000 feet deep, giving a vertical depth of 671 feet with levels called adit level (50 feet deep) 100, 300, 500, 700 and 950. Most of these except a part of adit level, 100 south and 950 level are inaccessible. On 100 level, the vein is 40 to 50 feet wide and is producing 20 tons of ore daily that should yield a small profit as it is cheaply mined. Just before the fire (March, 1925) another 20 tons daily was being mined in a raise 300 feet north of the shaft on 950 level. This is good looking sulphide ore, carrying pyrite and galena, and is near a pocket which yielded a few thousand dollars last summer.

No. 3 footwall crosscut on this level shows the footwall is a hard black dike, with a later layer of twisted marble lying between it and a schistose layer probably derived from diorite, the latter forming the intermediate footwall of the vein. A hanging wall crosscut and drifting north of the shaft shows ground-up quartz up to 10 feet wide, with successive layers of serpentine, limestone and black schist, the hanging wall of the series being a basic igneous rock, probably diorite, similar to the footwall. The face of the main adit north is in similar rock, the course having been turned northeast.

The present company operated the mill from December 1, 1920, until March 1, 1921, and from May to November, 1922, on low-grade material. It was again started early in March, 1925, and crushed about 50 tons a day until March 25, when a fire put the compressor out of commission, and mining was begun on the adit level. Here, early in April, three feet of ore on the hanging wall side of the 14-ft. vein, was giving good results in the mill.

The mill contains a rock breaker operated by 25-h. p. motor, 6′ x 8′ ball mill with 150-h. p. motor, plates, 4 Deister Plat-O concentrators, Ruth flotation outfit, cyanide tanks, Oliver filter and dewatering cone. Plating and concentration only are being done now. A total crew of 15 men is employed.



Mill of Carson Hill Gold Mines, Inc., at Melones.

Carson Hill Gold Mining Co. Main office 55 Congress Street, Boston, Mass., is the holding company and *Carson Hill Gold Mines, Inc.*, is the operating company, working Melones, Morgan, Calaveras and Chaparral Hill group of mines and adjacent claims extending from the northwest side of Carson Hill to Stanislaus River, and covering about 10,000 feet along the strike of the veins. The company owns the Morgan, Union, Kentucky, Iron Rock, Relief, Reserve, Enterprise, and Irvine and McMillan quartz mines, one-tenth interest in Finnegan Mine and other quartz claims and mineral rights on Carson Hill, a total of about 1100 acres.

Melones Mine was operated by Melones Mining Company from 1898 until November, 1918. The first 60 stamps (later increased to 120) were installed in 1901, and the mill was in steady operation until February, 1919. While there was considerable high-grade ore, the average grade milled was low on account of the method of mining, and the company reported at the time of stopping work that it was costing them about $20.00 an ounce to produce gold. Before the war they claimed to be operating for $1.60 per ton on an ore averaging $2.00 to $2.50 a ton.

The ore mined was principally a stringer lead carrying auriferous pyrite, in amphibolite schist on the footwall side of a massive quartz vein to the 1400 ft. level, and on the hanging wall side from there to 3500 level. The vein carried quartz, calcite, schist and some talc, and had a maximum width of 65 feet, and was stoped for an average of 25 to 30 feet wide. It strikes northwest and dips 70° to 1350 level, where the dip flattens to 50° northeast. At the 900 level, a fault (flat vein) striking N. 30° W. and dipping 30° to 45° NE. cuts the ore and 'bull' quartz vein and traverses the 'bull' quartz vein for about 200 feet on the dip, but did not displace the vein. Another fault or 'flat vein' of similar dip and strike intersected the 'bull' quartz vein at 1350 level and threw the lower section of vein 200 feet into the hanging wall. From there down, the ore was on the hanging wall of the 'bull' quartz vein, which as a rule is itself barren or low grade. On the 2500 level, the stope was 65 feet wide. From the surface to 1100 level, mining was done by means of an immense glory hole. The vein was stoped for a length of 480 feet on 200 level, 660 feet on 865 level, and 380 feet on 1100 level, and ore was taken out through the 1100 level tunnel which cut the vein 4000 feet from the portal. From this level a three-compartment winze was sunk to 3500 level. The mill particularly is described in detail in Report XIV of the State Mineralogist, pp. 95–96.

The mine was leased to Carson Hill Gold Mines, Inc., early in 1920 and then sold to them and has since been operated by that company. Melones Mining Company now retains only their hydro-electric property.

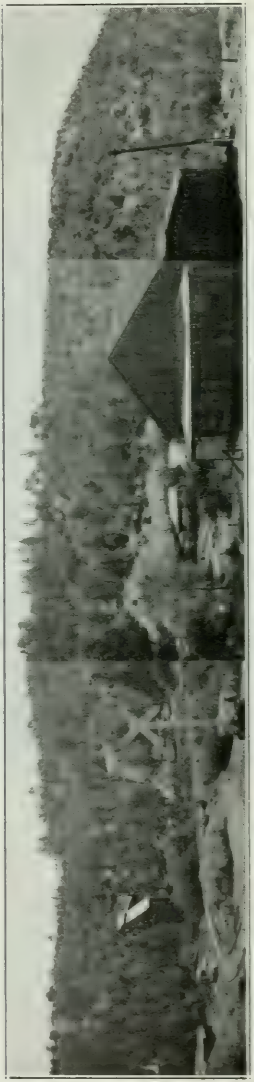
The Morgan Mine was discovered in 1850 by Hance, who took in six partners, one of whom was named Morgan. The ore was so rich in gold that it is said cold chisels had to be used at times to cut it,[1] and the largest single piece of quartz gold ever mined was reported to have been found here.[2] Stories of the bonanza attracted thousands to the camp of Melones. The Morgan ore was worked in mortars and arrastras, and besides the $2,800,000 reported to have been realized by the owners between February, 1850, and December, 1851, it was known that a great deal was stolen by the Mexican miners. In 1852, the mine was seized by a small army of outsiders who drove off the owners and operated the property for nine months, until removed by injunction.

After this romantic beginning, the mine passed through the usual periods of litigation, idleness and operation on a small scale, having lain idle for over ten years when reopened in 1918 by *Carson Hill Gold Mines, Inc.* During this latter period, Melones Mining Company had been working nearby, some of Melones workings having been separated

---

[1] Raymond, R. W., Mines and Mineral Resources of the U. S. West of the Rocky Mountains, 1868.

[2] Tucker, W. B., State Mineralogist's Rept. XIV, p. 97. 1915.



Panoramic view of Carson Hill, Calaveras County, looking south. Old glory hole of Melones Mines and Finnegan Mine on the left. The upper workings of the Morgan mine in back of loading bin in left side of picture.

from the rich Morgan ore-shoot by the thickness of the 'bull' quartz vein.

High-grade milling ore was found in the Morgan Mine on the hanging wall side of the 'bull' quartz vein on the 300 level and was stoped up to 200 level. It was followed downward with good results. The vein, a branch of the Mother Lode, strikes nearly north and dips 50° to 70° E., and the ore-shoot pitched south. As originally worked in 1919, this ore-shoot was stoped for a length of from 140 to 200 feet and a thickness of over 30 feet, and during 1919, the mill heads averaged $14.95 a ton. The hanging wall of this orebody is greatly altered amphibolite schist, and there was indeed no distinct hanging wall, as the orebody had evidently been formed by the mineral-bearing solution rising along the footwall, and altering and replacing the soluble minerals of the hanging wall to a sufficient extent to form ore, with the deposition of about 4% of sulphides, which proved to be worth about $100 a ton as concentrate. Much of the good ore was characterized by graphite, and by a talcose gouge. The footwall of the orebody was the solid 'bull' quartz vein, six feet or more thick, followed by the lower-grade footwall amphibolite schist orebody, which had been previously worked.

The Morgan hanging wall ore-shoot has been worked to the 1450 Morgan level. It was stoped 350 feet long on the 550 level, 280 feet long on 675 level, 265 feet long on 865 level, 225 feet long on 1100 level and 315 feet long on 1300 level. The southerly pitch of the ore-shoot carried it into Melones Mine a little below the 1450 Morgan level. This shoot was the mainstay of the Morgan Mine. The faults or 'flat veins' mentioned under Melones Mine are termed the '675 flat vein' and '1100 flat vein' in the Morgan Mine. Both these veins are stoped, yielding low-grade ore, worth $4.50 to $5.00 a ton, and of a maximum width of 20 feet, though averaging 10 feet to 12 feet.

Melones Mining Company had previously mined on the hanging wall side from the 1350 to 3500 level. There was a so-called barren or lean zone from about 2170 feet for a depth of about 600 feet, where little ore was found. Carson Hill Gold Mines, Inc., sank a new internal shaft from the 3000 level 225 feet south of the bottom of Melones shaft, on a 57° incline to 4550 level, and opened levels 125 feet apart. Lately they have been working on the 3500, 3875, 4000, 4125, 4250, and 4375 levels. In March, 1925, ore was being stoped on the 4125, 4250 and 4375 levels and averaged 18 to 20 feet thick, with a southerly pitch still persisting.

The following figures show the average value of ore milled, and amounts recovered by this company since milling operations began in January, 1919, up to the end of 1924:

Year	*Average recovery*	*Tons*	*Recovered Value*
1919	$14.95		$992,149
1920	11.54	111,662	1,093,900
1921	6.82	175,666	1,067,247
1922	6.27	183,733	1,035,757
1923			995,332
1924			715,386

From 1921 onward, the mill handled an average of 15,000 tons a month, or more, except in 1924, when work was curtailed by water and power shortage.

The milling process consists of crushing the ore to 20-mesh with thirty 1250-lb. stamps, classifying, overflow going over plates and sand to Hardinge mills for regrinding; thence over plates to Deister Simplex sand concentrators and Deister Plat-O sand tables. Average stamp duty has reached as high as 18.44 tons a day.

The distribution of recovered gold was about as follows in a representative year on the lower-grade ore: Bullion 55%; concentrate 27.6%; sand and slime 17%. For the richer ores, mined in 1919–20 in the upper levels of the Morgan, the distribution of gold content was: In bullion, 65.58%; in concentrate, 23.01%; in sand and slime, 11.41%. The bullion was worth $18.90 an ounce in 1919. Concentrate, sand and slime are cyanided. Recovery from concentrate averages 92%, as per contract; on sand and slime the average recovery has been about 68%. Tailing loss has ranged from $1.26 per ton in 1919 to $0.60 per ton in 1922.

Representative cost figures for operations at this group of mines are hard to arrive at, because work has been carried on under different conditions in different workings, as for example during 1922 when ore from the Morgan Mine was coming entirely from above the 1100 level, and that from Melones Mine from between 3600 and 4000 levels, with average costs representing rather wide extremes. Of a total mining cost of $1.473 per ton crushed in 1922, the largest items were labor $0.737 per ton, and explosives $0.192 per ton. Timber, power, repairs and maintenance ranged from 3½¢ to 4½¢ each, per ton crushed (for mining) and tools 6¢ to 6½¢ a ton.

Cost of reducing the ore and marketing were as follows in 1922, per ton crushed:

Stamping, amalgamation, regrinding, concentration	$0.431
Treatment of sand and slime	0.663
Marketing	0.013
General expense	0.558
Total	$1.665

The mill handled an average of 15,300 tons a month that year, an average of 27.67 stamps giving an average duty of 18.44 tons a day each.

The total crew employed at that time in Morgan and Melones mines was 232 men, of whom 185 to 190 were actually employed in mining.

Chapman (McGary) Mine. On McGary Ranch, in Railroad Flat district. This is one of the very old quartz mines developed 50 years ago by a shaft 210 feet deep, with drifts north and south from which considerable ore was stoped and milled. The mine was reopened by Goddard-McKay Mines Company of Sacramento in 1924. A ball mill was installed and some ore was milled, but early in 1925 the company failed to meet the terms of their option and quit work. Later in April, 1925, the surface plant was burned down for the second time since the reopening.

Calaveras Mine. This group of claims near Melones has been under lease and option for several years to Carson Hill Gold Mines, Inc., and has been prospected at intervals, with some production. The ore developed on the lower levels runs $5 to $7 a ton, and although the mine showed very good promise when being worked in 1919 and 1920, the company did not feel inclined to work it extensively at the time as they had just opened and were exploiting the high-grade Morgan Mine ore-shoot. The Calaveras has therefore not been developed much since 1919. Up to 1923, the operators reported they had made a gross production of $46,579 from the Calaveras, and during 1924 the property produced 5,282 tons of ore which was treated in the company's mill with its other ore.

The vein has been developed by an adit entering the hill near Melones and following the vein nearly north for 2000 feet or more; ahead of this, the vein outcrop was extensively prospected by trenching. The main adit is called 1000 level, all levels on this and adjoining properties worked by this company having been referred to the apex of the vein on the New Year claim on the summit of Carson Hill. From this adit, 950 feet from the portal, a winze was sunk and levels opened at 1123, 1250 and 1375 feet, from which several hundred feet of drifts were run, mostly north. The vein averages 15 feet wide, of which 7 feet is classed as ore. Both walls are amphibolite schist, the footwall swelling and the hanging-wall heavy, requiring close timbering and hard to hold open long. The old operations were through a shaft 600 feet deep, but recently nothing has been done in the worked-out area above 1000 level.

The Calaveras Mine has often been regarded as on the main Mother Lode, and the adjoining Morgan and Melones as being on a branch from the main lode. The distinction appears of little importance in the light of the developments and production of the last two named mines.

Bibl: State Mineralogist's Report, XVII, p. 421; XIV, p. 73; XIII, p. 99; X, pp. 56-57; XI, pp. 169-170. Bull. 18, p. 123.

Chaparral Hill Group. This property comprises seven patented claims and two millsites in Secs. 11, 14, T. 2 N., R. 13 E., 95 acres in all, on Chaparral Hill between Angels Camp and Carson Hill. Owners: Melvin C. Meeker, Jr., and Effie M. Meeker of Camp Meeker, Sonoma County, each one-third; Chaparral Hill Operating Company (subsidiary of Carson Hill G. M. Inc.) of Carson Hill, one-third.

During the past three years the Chaparral Hill Operating Company did considerable prospecting work on these claims, working through the nearby Hardy shaft. No important ore discoveries were reported.

Bibl: State Mineralogist's Report XIV, p. 73.

Demarest Mine. Owner: Demarest Gold Mining Company, care Lawrence Monte Verde, Altaville. Comprises one patented claim of 13.79 acres in Lot 39, in NE¼ of Sec. 16, T. 3 N., R. 12 E., with 129 acres of land adjoining in Secs. 9, 15, and 16. There is an old 5-stamp mill, hoist, boilers, engines, compressor and other old equipment on the claim. The property has been idle a number of years, but was formerly worked through a shaft 700 feet deep and made a fair production from the upper levels. It has lately been taken under option by A. J. Fazzi of the Jolly Tar Mining Co.

Bibl: State Mineralogist's Report XII, p. 92; XIV, p. 96. State Min. Bur. Bull. 18, p. 107.

Dominion Mining Organization, Inc., 306 Merchants Exchange Building, San Francisco, did some prospecting work the past three years on a group of 22 unpatented quartz claims and other unpatented land in Sections 25, 26, 35 and 36, T. 7 N., R. 13 E.; Sec. 6, T. 6 N., R. 14 E., and adjoining parts of the West Point district, and also on several old mines including the Zacatera, Star of the West, Wide West, Modoc and others, in the same district.

The company has planned to drive a long tunnel to tap a number of veins at a depth of 1000 feet below the bottoms of the old workings, which in most cases have not exceeded 200 feet. This tunnel work was temporarily stopped after going several hundred feet, and the project is idle for the time being. There is an air compressor, gas engine, shop and building on the property.

Easyz Bird Mine, Pacific Gold Mining and Milling Co., care Max Muller, Nogales, Arizona, owners. Under option March, 1925, to E. R. Abadie et al. It is three and a half miles by road from Mokelumne Hill, in W$\frac{1}{2}$ Sec. 6, T. 5 N., R. 12 E., on the south side of Mokelumne River. About 400 acres in unpatented land are held under option, including this old mine and adjoining claims.

Several of the claims have been worked in a small way by successive stock companies. Mine was in operation from 1898 to 1907, then from 1914 to 1917, since when it has been idle. No records of past output are available, but it is stated to have paid a small profit to some of the operators, and the last work is said to have paid a profit until costs went up during the late war.

The Easyz Bird vein strikes N. 60° to 80° E. as shown by occasional croppings across the west half of section six, but does not outcrop continuously. Several faults, and a number of quartz veins, including the Challenge, Fraction, J. P. Morgan and other veins, intersect the main vein and ore-shoots have been mined at these intersections. The country rock is granodiorite, but underground relations could not be viewed as the mine was inaccessible at the time of visit. The main vein has a maximum width of 50 feet, with an average width of nine feet in the ore-shoots according to the mine map. It dips N. 45° W. The cross veins strike south to southeast and dip east.

Development consists of an inclined shaft 303 feet deep on the dip, a main adit level and levels at 50, 100 and 200 feet; the main adit is a crosscut 232 feet with a drift on the vein 695 feet east and 1020 feet west. Besides this the 50 foot level was run 52 feet, the 100 foot level was drifted east 390 feet and west 307 feet, and an uncertain amount of work was done on the 200 foot level. Seven stopes, varying in length from 35 feet to 110 feet were worked above the main adit, which is 83 feet vertically below the collar. According to the mine map, the lower levels were run far enough to prove only two of these shoots, which were stoped a little on the 100-foot level. Two faults are mapped, one 60 feet east of the shaft, another 50 feet west of the shaft, which moved the vein north, looking east.

The mill includes a Knight crusher, bucket elevator, 6-foot ball mill, plates, Dorr classifier, four Callow cones, eight concentrators, and electric motors, and is in good condition.

Empire Mine lies south of Royal Consolidated Mine. Carries base ore, with high-grade concentrate. Bishop & Hobart, owners (?), San Francisco.

Finnegan Mine. This mine comprises two patented claims on the northeast slope of Carson Hill and contains 11.29 acres in Sec. 13, T. 2 N., R. 13 E. It adjoins Melones Mine on the same orebody that was worked by open cut so many years by the latter company. The principal production from the Finnegan has been obtained by the same method of mining, and the ore has been for the most part of similar low grade, being a mineralized schist and stringer lead 30 feet to 100 feet wide on the footwall side of a bull quartz vein. The open cut adjoins and forms a part of the old Melones glory hole, which for years stood open to a depth of 1100 feet, but caved in a year or so ago. The Finnegan workings however, have been shallow, less than 200 feet deep.

Since our Report XIV the property has been operated occasionally for short periods but production has been small. The plant was rebuilt in 1921 by Lewis, Gilman and Moore and the 10-stamp mill was last operated by Thos. C. Tarbat for himself and other owners during 1923–24. Early in January, 1925, the interest of Thos. C. Tarbat in the property was attached by the sheriff on account of a judgment rendered in favor of Charles Valconesi.

Bibl: State Mineralogist's Report XIV, p. 79; XIII, p. 104; XII, p. 92; XVII, p. 421.

Fish Group. L. B. Fish, owner, Railroad Flat. Includes Stand-by Mine and Millsite, Lots 83, 83a in NE¼ of Sec. 35, T. 6 N., R. 13 E., and Fish and Dellinger quartz claims. Prospecting has been going on and a 4-stamp prospecting mill has been installed.

Forest Creek Mining Company. Reported to have an adit 300 feet on a ledge from six inches to twenty-four inches wide, with high assays. Is in West Point district. D. Terhorst was president, Frank Aderhald, superintendent. Hauled in machinery but evidently quit. On Middle Fork of Mokelumne River. Resumption of operation was planned in April, 1925.

Gold Knoll Mining Company. This is a stock company formed to work prospects on the Womble Ranch, which includes the old *Wilbur Womble Mine.* The old mine is in the SW¼ Sec. 29 and the present operations are in the NE¼ Sec. 32, T. 2 N., R. 12 E., adjoining the old town of Hodson, 14 miles from the railroad station of Milton. There are 480 acres in the holdings. E. E. Schmitz, president, Herbert Schmitz, secretary. Office 925 Hearst Building, San Francisco, Alexander Boyle, manager, 364 Bush Street, San Francisco.

The new shaft is 3000 feet southeast of the old one. It is 275 feet deep on the incline and besides the adit level, there is a No. 1 level 115 feet deep on the dip. The vein is a stringer lead in slate and schist, striking northwest and dipping 45° NE. with some outcrops of solid quartz. On the adit level, about 50 feet deep, 640 feet of crosscuts have been run and have blocked out a wide stringer lead in slate. It is oxidized and has yielded numerous good assays according to Boyle. An east crosscut on No. 1 level was run 234 feet into the hanging wall and had failed to cut this lead, and conditions are such as to indicate the possibility of either a tapering of the orebody, or a movement of the upper segment eastward. On the No. 1 level, a drift was run northwest 50 feet from the shaft, and a crosscut at the face was driven 15 feet northeast and 40 feet southwest. This shows the black slate footwall, badly crumpled and twisted. The section of vein, which is stated by the manager to be of milling grade, is about 19 feet wide. A dike, completely altered, lies in the vein near the footwall. The immediate hanging wall is an altered dike, probably diabase or 'greenstone' originally, followed by slate and farther in the hanging wall by serpentine. The footwall gouge here has a normal dip, steeper than that of the hanging wall, and suggesting the possibility that the vein may be widening below. The bottom of the shaft was in black slate, in the footwall of the vein opened above.

Equipment here includes electric hoist, 350-cubic-foot air compressor, blacksmith shop and electric transformers taking power from P. G. and E. Company. The underground work has been done well and is in good shape.

The old mine was worked by a glory hole 900 feet long, 50 feet wide and 100 feet deep, with a shaft reaching a depth of 185 feet, or 132 feet vertically. The pay-shoot worked is said to have been 450 feet long and 50 feet wide, and according to a former report of this Bureau, averaged $3 in free gold and two per cent of low-grade concentrate. There is an old 15-stamp mill near the old shaft.

Bibl (for Wilbur Womble Mine): State Mineralogist's Report XIV, p. 113.

Hardy Mine. Owners: Estates of A. J. Hayward and W. S. Hobart each one-third et al., care Utica Mining Company, Angels Camp. Comprises the Hardy Mine, 6.19 acres, and McCreigh & Reed, 2.86 acres, in Secs. 11, 14, T. 2 N., R. 13 E., on the north slope of Chaparral Hill, 3 miles south of Angels Camp. Property was prospected in 1922–23 by Chaparral Hill Operating Company, an exploration company subsidiary to Carson Hill Gold Mines, Inc. It had formerly been worked through an adit 360 feet long and a winze, and had produced a number of good-sized pockets from a large white quartz vein, where it came in contact with porphyry. The old shaft, 170 feet deep, was used as an entry for the recent work.

Hawkins Group comprises 12 claims, some claimed by adverse owners, in SW¼ Sec. 34, T. 6 N., R. 12 E., in Rich Gulch Mining district, on the south side of Mokelumne River. E. F. Hawkins, P. O. Box 371, Stockton, California, and wife are the principal owners of Hawkins Gold Mining Company. Claims are reached by road and trail from Mokelumne Hill and West Point road via Raymond Davis Ranch, and extend from an elevation of 1000 feet near the river to over 2000 feet on Altamont claim.

A number of veins in granodiorite have been prospected by trenches, open cuts and adits. The strike of veins varies from west to northwest. Bunker Hill and Bunker Hill No. 1 claims have been prospected by open cuts. On Bunker Hill No. 2 there is an adit 250 feet long. There is an old 5-stamp mill which might be repaired and operated by water power, on this claim. This mill is above the first two claims mentioned, but could be used in milling ore from the claims above on the slope.

On the Altamont, Twin Tunnel and L. G. M. claims a vein has been prospected by open cuts.

Electric power is two miles distant and the Mokelumne Hill ditch crosses the upper claim 1000 feet above the river.

Indian Creek Gold Mining Co. George S. Walker, president. This company operated during 1924 on the Maria and Fortuna claims in Sec. 34, T. 4 N., R. 13 E., near Esmeralda. An adit had been repaired and advanced to a length of 400 feet during last July, but work was interrupted soon after by the death of the engineer in charge.

Lamphear Mine. Owner: Roanoke Mining Co., 2035 Oakland Ave., care L. S. Wetmore, Piedmont, California. Comprises Lot 46 and adjoining land in NE¼ of NW¼ of Sec. 18, T. 5 N., R. 12 E., a mile south of Mokelumne Hill. This property has been under lease and option to Lamphear Mining Company of Mokelumne Hill. Since the last report this company installed electric-power hoist with speed of 300 feet per minute, Gardner turbine pump, capacity 100 g. p. m.; and other equipment. The workings were unwatered after considerable difficulty, by combined baling and pumping, and were explored and sampled, but on account of lack of finances the company was unable to do much new work.

The Lamphear vein strikes northeast and dips 45° southeast, between an amphibolite schist footwall and slate hanging wall, and pinches and swells. It has been developed by an inclined shaft 300 feet deep in the footwall with a dip of 10° steeper than the vein. A level was turned at a depth of 115 feet and the vein was stoped 260 feet on the south and for an uncertain distance north. A crosscut at 180 feet showed a pinch in the vein, but at the 280 level, drifts were run 100 feet south and 70 feet north. The north drift is said to be in ore beginning 15 feet from the shaft and extending to the face where the vein is four and a half feet wide with two feet of gouge. Robert Irvine who was in charge of the last work, states the vein is six to eleven feet wide in the bottom and assays $4.80 per ton on the north side, but is poor on the south. The ore carries 3½% of concentrates, of which 1% is galena, and concentrates assay about $65 a ton. The mine has a record of $118,000 production.

The property was taken under lease and option April 24, 1925, from the Lamphear Mining Co. by parties who expect to reopen it at once.

Maltos and Mexican Claims. J. Maltos, 1802 South San Joaquin Street, Stockton. They include 30 acres adjoining the Royal Mine at Hodson on the footwall side and contain a vein three feet to four feet wide which has produced some pockets and is thought by the owner to be the extension of the Mountain King vein. There is no equipment on the claims.

Mountain King Group consists of seven patented claims adjoining the Royal Mine on the northwest in Secs. 19 and 30, T. 2 N., R. 12 E., near Hodson and 12 miles from the railroad terminus at Milton. Owner, R. B. Parks, 130 East Walnut Street, Stockton.

The Mountain King, Wm. K. Bulger and Last Chance claims cover a total length of 2844 feet on the lode. The footwall is black slate, and according to a report by Byron E. Rowe, from which the following notes are summarized, "the veins are in the amphibolite schists at the contact with the Mariposa slate, mineralization being controlled largely by numerous fractures and intrusions of small veins of quartz which traverse the amphibolite schists in all directions and exhibit heavy mineralization wherever contacting the vein."

The vein has a well-defined outcrop with a maximum width up to 50 feet, strikes N. 60° W. and varies in dip from 31° to 20° N.E. The vein is reported to be the same one worked near the line in the Royal Mine.

The principal shaft is a 28° incline 1044 feet deep, passing into the hanging wall schist in the lower section, due to steepening of the vein. Six levels were turned from this shaft, called one, two, four, five, six and nine. On each of levels one, two and four about 100 feet of drifting was done, and on level four a stope 28 feet long by 40 feet high was mined, but work was discontinued because of the narrowing of the vein, which might open out again if followed. On level five, which is 55 feet below level four, a drift was run northwest 150 feet and southeast 100 feet. On the northwest, beginning 35 feet from the shaft, 500 tons of ore milled in 1915 showed a reported average value of $5.25 a ton. This shoot was about 110 feet long according to Rowe. Number six level was drifted northwest 307 feet, of which the first 135 feet were reported in ore that was followed to the next level by a raise. The vein continued narrow in the drift for the next 100 feet, then widened into a large low-grade body of quartz. The ninth level is 259 below level six. The intersection of the Pine Log vein with the Mountain King vein is reported on this level and the results of drifting over 200 feet southeast here have been inconclusive so far, due to disturbed conditions on that side of the shaft. On the northwest, the drift passed on hanging wall side of the ore shoot developed above. The northwest drift is about 320 feet long, the last 70 feet being in the large low-grade quartz body found above. The bottom of the shaft is 245 feet below the ninth level.

The Bulger shaft is 1000 feet northwest of Mountain King shaft and is 110 feet deep. The vein is narrower and higher grade here, and some small dikes were observed, entering from the Mariposa slate on the footwall.

There is held to be a possibility of encountering the Royal oreshoot by drifting southeast from the present bottom, or by sinking 500 feet in the main shaft, as this shoot was mined to within a short distance of the property line.

The property is equipped with 10-stamp mill, air compressor of 750 cubic feet capacity, shop, and other buildings.

Mowhawk Mine. F. M. Raymond, owner, Altaville. Contains six acres in SE¼ Sec. 31, T. 3 N., R. 13 E., two miles from Angels on Copperopolis road, adjoining Osborne Ranch on the west.

A shaft 110 feet deep, with a crosscut 300 feet long northeastward on 100-foot level, has developed a stringer lead of quartz and schist. A black slate gouge with three feet of broken quartz was struck about 50 feet from the shaft, then 100 feet of black slate or schist, and then a body of hard green twisted schist. High grade ore was found 200 feet from the shaft and was followed upward 35 feet. Four or five tons of this ore yielded $600 or more. In all, the claim is said to have produced about $8,000, mostly from a series of shallow holes 20 feet to 50 feet deep. The gold is reported to have been found in large bunches of soft manganese oxide.

There is a 2-stamp mill, with plates and rock breaker, and electric motors, hoist and pump. Last work was done in April, 1924, by Chase Brothers.

Old Calaveras Group includes Enchantress and Oro Minto Claims, Lots 46 and 47 in Sec. 21, T. 4 N., R. 14 E., six miles north of Murphys. Wm. M. Nuner and estate of John Waters, San Andreas, owners. R. C. Johnson took a lease and option on these claims in January, 1924, and unwatered some of the old workings, but did little except repair work underground. Idle, March, 1925.

The Oro Minto had a shaft 130 feet deep, and the Enchantress one 110 feet deep, as early as 1872, and had produced a few tons of rich ore. The deeper shaft was subsequently sunk to a depth of 600 feet, and a mill was put up about 1875. The mine is reputed to have had a rather large output, for which definite figures are not available. The vein strikes north of west and dips northeast and averaged two feet wide, increasing sometimes to five feet. It is in the Calaveras formation and carries free gold, pyrite, galena and a little zincblende.

Bibl: State Mineralogist's Report XIV, p. 100; XIII, p. 115.

Red Top Prospect. In the summer of 1924 Red Top Mine, Inc., a Nevada corporation with office in 930 Stock Exchange Building, Los Angeles, made an agreement to purchase two unpatented quartz claims from Joaquin Leonard. The claims are five and a half miles from Douglas Flat via Adams Ranch and are in the northern part of T. 3 N., R. 14 E., at an elevation of 2700 feet.

A shaft was sunk 60 feet on a vein three feet wide striking NW. and dipping 47° SW. The vein is broken on the south face. Drifts were run 30 feet each way and a carload of ore was shipped which was reported good grade. A headframe was being erected and hoist and 10″ x 12″ compressor were to be installed when work was held up by a lawsuit over the ownership of ground adjoining, in which the company was interested.

F. H. Rindge, 711 Farmers and Merchants Bank Building, Stockton, has been engaged for several years in mining and prospecting operations in the Jesus Maria district. His first work was placer mining on the old Noce Placer Mine on Whiskey Slide Hill, where considerable equipment was installed and hydraulicking was carried on. More recently a prospect shaft has been started and is being sunk with a depth of 1000 feet as the reported objective before much exploratory crosscutting and drifting is done. Surface indications on the vein are stated to be promising, but the shaft, which is now several hundred feet deep is not following the vein at present.

Rindge has consolidated 1243 acres of land in Secs. 11, 12, 13, 14, 23, T. 5 N., R. 12 E., and in Secs. 18, 19, T. 5 N., R. 13 E., and in Secs. 30, 31, T. 6 N., R. 13 E. He is employing 15 to 20 men in his prospecting work.

Royal Consolidated Mines at Hodson have been idle (except for small operations by lessees in the upper levels) for several years. Address Frank Tower, Felix, via Milton, California. Tower plans to resume work underground soon, and surface preparations are now going on (April, 1925) with this end in view.

Bibl: State Mineralogist's Report XIV, p. 103; XIII, p. 117; XI, p. 168. Cal. State Min. Bur. Bull. 18, p. 126.

Sheep Ranch Mine has been the best producer and the deepest developed mine on the East Belt in this county. As an illustration of the geology of this belt, in which no deep mines are open at present, the writer is repeating here an article written after he visited the property in November 1921. At the time of visit, ore going to the mill was reported by the operators to be assaying $14 a ton, and it was costing $10 a ton to work it, with a crew of 57 men of whom 38 were working underground. There was always a great deal of trouble caused by high-grading, as the property was characteristically a 'high grade mine.' The concentrate was of little value as a rule. The mine was shut down and machinery removed very shortly after those notes were written, and has been idle since, except for the work of three men who are at present milling some of the dump in a miniature stamp mill. C. L. Feusier, owner, Sheep Ranch.

"The last company, between 1919–1922 unwatered and repaired the workings, sank the shaft to 1700 feet and sank a winze from 1300 to the 1700-foot level, 750 feet east of the shaft. A sub-level at 1400 feet has been driven 200 feet west and 250 feet east from this winze, the 1550-foot level has been driven 1100 feet east and 300 feet west of shaft, with ore in a series of lenses all the way; and the 1700-foot level has been driven the same distances. At time of visit in November, 1921, stoping from the 1400-foot sub-level had reached the 1300-level, stoping was going on from the 1500-level, and a stope had just been started from the 1700-level, all east of the shaft.

Surface plant, Sheep Ranch Mine.

"The vein was generally narrow, but swelled to a width of three feet or more, and occupied a strongly defined fissure which struck N. 55° W. and dipped 70° to 75° NE. in hard, black, siliceous mica schist. Dikes of gabbro or diorite, probably connected with the large gabbro mass to the north, have crossed the vein. The hanging wall showed loose slabs and lenses of graphitic schist, and the tendency of these to fall made careful stoping necessary, for motives of economy as well as safety. A dike appeared on the 1550 and 1700 levels east of shaft.

The vein approached this crossing on the footwall side of the fissure on the 1550-level, narrowed near the dike, and beyond it took the hanging wall side of the fissure.

"The ore was quartz, sometimes bluish in color, and occurred in a series of irregular lenses that sometimes overlapped. It was apt to change suddenly from medium to high grade or vice versa, and this condition increased the difficulties and uncertainties of operation. The continuity and richness of the vein, however, were indicated by the extent of the old workings, in which an average thickness of five feet was stoped for a maximum length of 1400 feet to a depth of 1300 feet, giving a reported yield of $4,000,000 from 400,000 tons of ore. The pay was principally in free gold. A mixture of various sulphides of iron, copper, lead and zinc, etc., were said to make up only one-half of one per cent of the ore.

"Centrifugal pumps were used on the 850 and 1300-levels, and a Dean Triplex pump on the 1700-level handled about 125 gallons of water a minute to the 1300-foot level. A total of about 200 gallons per minute was pumped to the 300-foot level where it drained off through a tunnel 2400 feet long.

"The last company started the mill December 24, 1920. Ore was hoisted to the headframe and dumped on grizzlies, where the coarse ore was sorted by two men, then crushed in a 12-inch by 15-inch rock breaker and trammed to the mill bins. Twenty 850-pound stamps dropping 104 times a minute crushed the ore in cyanide solution and discharged at a height of three inches through a coarse punched screen. Pulp from the stamps passed over Hungarian riffles to catch coarse gold and was then classified, the oversize going to a 5-foot by 16-foot tube mill in closed circuit, and ground to about 150 mesh. Entire product was cyanided. It was thickened in a 10-foot by 26-foot Dorr thickener to about 45% solids. Solution from the thickener went to clarifier, thence to gold tank and zinc boxes. Pulp went to three Dorr agitators in series, and thence to four Dorr thickeners in series, which gave a product about 70% solids, and solution passed to clarifiers and to the gold tank and zinc boxes for precipitation. A small part of the solution from the zinc boxes after precipitation of the gold was returned to the agitators to bring the pulp to a consistency of 1:2 but most of it went to No. 4 thickener as a wash. A battery storage tank held 125 tons of solution carrying 0.75 pound of cyanide per ton. About three and one-half pounds of lime and 0.9 pound of cyanide per ton of ore were used."

Bibl: State mineralogist's Report VIII, p. 131; XI, p. 175; XIII, p. 119; XIV, p. 104. Cal. State Min. Bur. Bull. 18, p. 104.

Sherman Ranch (New York-Calaveras or *Ranch Mine)* is five miles northwest of Hodson. It has been prospected by two shafts between 100 feet and 200 feet deep, and a small amount of drifting. It contains a flat vein five and a half feet wide. Address J. McCarty, Felix, via Milton.

This property has lately been sampled (March, 1925) and there is a possibility that it may be reopened.

Tollgate Mine (Port Arthur claim and *Prince property)* one-half mile southwest of Altaville on Copperopolis road. A vein strikes N. 65° W. in amphibolite schist. An inclined shaft has been sunk 150 feet with levels at 100 and 150 feet. Forty tons were milled from the 100 level and reported as yielding $7.50 a ton, half of it in the concentrate. On the 150-foot level about 50 feet of crosscut and drift was run and 21 feet of this crosscut showed very low assays, according to G. A. Ross. Property is idle.

There is a 3-stamp mill, one vanner, hoist and buildings. Last work was done by Tollgate Mining Company.

Triple Lode Gold Mines, Inc., last address, 68 Post St., San Francisco. (Blair Cons.; El Dorado, Jumper Claims.) This company did some work between 1920 and 1923 on the above claims in Sec. 32, T. 3 N., R. 13 E., one and one-half miles southwest of Altaville. The old shaft was 450 feet deep, with levels at 150, 200 and 400 feet, where short drifts were run. New work consisted of a new shaft 250 feet deep, 800 feet north of the old shaft, in the footwall. Levels were turned from this shaft at 150 and 250 feet. On 150-foot level a crosscut was run 300 feet to the 'East Vein' and 60 feet was run on the 'Shaft Vein.' On 250-foot level, they ran a crosscut 300 feet to the East Vein, on which they had drifted 200 feet at the time of last visit, and also drifted 80 feet on a smaller vein. A mill of 20 stamps was brought from the Hardenburg Mine in Amador County but was not erected. There is also a 10″ x 12″ air compressor, electric power equipment, pump, air hoist, and buildings.

The property was advertised for sheriff's sale February 11, 1924, to satisfy laborers' liens held by Albert Prothero. It had previously been sold at Commissioner's sale, May 19, 1923, to Henry Demaria. The underground workings were not visited as the hoist was not running at the time of visits.

Tullock Mine. Owners: Estate of James Tullock, Mrs. Lillie Bisbee, and Mrs. Emma Sell, Angels Camp. It is in the south part of Sec. 11, T. 2 N., R. 13 E., on Albany Flat, two and one-half miles south of Angels Camp. It is on a branch of the Mother Lode with usual dip and strike and the ore carries more galena than usual for this lode. In 1922 the shaft 800 feet deep was unwatered for examination by Chaparral Hill Operating Company, but no new work was done. In March, 1925, the property was taken under lease and option by J. F. Merritt, who planned to unwater it.

> Bibl: State Mineralogist's Report XIV, p. 110; XIII, p. 121; XII, pp. 98 et al. Cal. State Min. Bur. Bull. 18, p. 121.

Washington (Bullion Hill) Mine is in Sec. 20, T. 4 N., R. 14 E., six miles north of Murphy, just west of Sheep Ranch road, and includes one full claim and a fraction. Owner: W. Oslin.

An old adit had previously been driven 1200 feet, following the vein N. 70° E. for 800 feet and giving 200 feet of backs at the face. This vein had been stoped from the adit to the surface for 200 feet in length and the mine had lain idle for years when *Bullion Hill Mining Company* began work in July, 1921. They operated for two years. The adit was extended 100 feet and lens-shaped orebodies were worked for a length of 135 feet above the adit. The vein is of solid quartz and ribbon rock, three feet to six feet wide, and carries free gold and as high as 10% auriferous pyrite and galena with reported traces of zinc, antimony and manganese. Operations paid for a time, but were stopped by lawsuits, after the best ore in sight had been mined, and the property reverted to the owner.

In April, 1924, Fraser and Hibbard of Los Angeles began work and have been running five stamps of the 10-stamp mill intermittently while prospecting for more ore. A winze has been continued to a depth of 100 feet below the adit and drifts had been run 90 feet east and 65 feet west from it at this depth, but good ore had not yet been opened at the end of March, 1925. Lessee with option: Washington Gold Mining Co., Jack Hibbard, president.

Bibl: State Mineralogist's Report XVIII, p. 98; Cal. State Min. Bur. Preliminary Report 8, pp. 25–26.

GOLD MINES (PLACER).

Drift and hydraulic mining have not been very productive in late years in the county, although the unworked gravel deposits are extensive. Most of the new work in this line in the past five years has been on the Central Hill-Vallecito Channel system between Parrot's Ferry and Dogtown. The only producers in the section mentioned have been the *Victor Mine* (Rainier) near Altaville and the *Last Chance Mine* at Vallecito. The former is now closed down, and the latter is producing profitably from some sections of rich gravel left by old time miners who worked out most of the good ground. *Vallecito Western Mining Company, Inc.*, under the management of Don Steffa has drilled ground belonging to the Bishop Estate on this channel system on Six-Mile Creek between Angels Camp and Vallecito and has just completed a shaft from which prospect crosscuts and drifts have been started (May 1, 1925) to explore the ground. *Calmo Mining and Milling Company* under the management of Wm. M. Grafflin has put up substantial works on the *Slab Ranch* property between the Victor and Vallecito Western, and has sunk a vertical shaft 200 feet deep from which the channel is being prospected. Up to this time, no pay gravel has been extracted.

The gravel in this section has to be mined by shafts as it is below the present drainage, and considerable water has to be pumped.

The *Old Stiff Mine* near Vallecito is being reopened and early in April the shaft was reported to be opened 142 feet deep.

Elsewhere in the county, mention may be made of a few activities since the last report.

Chili Gulch Mining Company has brought in electric power and is installing a drag-line scraper on *El Encino Gravel Mine,* which covers 3000 feet in length along Chili Gulch and a width of 200 feet. It is proposed to work off the tailings which accumulated in the gulch from early day operations. This deposit is a loose, medium-sized white quartz gravel.

Frederick H. Rindge of Stockton did some hydraulic mining at the *Noce Mine* at Whiskey Slide, getting pressure by pumping the water. He has lately turned his attention to quartz prospecting.

At the *Green Mountain Extension Mine* adjoining the old Green Mountain Mine, a mile and a half south of Mokelumne Hill, an adit is being driven and it is expected will be about 700 feet long when it reaches the channel, during the present summer.

The gravel resources of the county have recently been covered in our Bulletin 92 'Gold Placers of California' to which the reader is referred, as well as to other references in the general bibliography accompanying this report.

Dredging operations were covered in our Bulletin 85, 'Platinum and Allied Metals in California' and in addition to what is noted there, it may be observed that since that bulletin was written, El Oro Dredging Company has finished its ground near Jenny Lind and operations have been continued on the Calaveras River at Jenny Lind by the *Isabel Dredge*, Ivy L. Borden, owner, and on Mokelumne River, near Camanche and westward by *American Dredging Company*. The latter companies and Carson Hill Gold Mines (quartz) have been the principal gold producers of the county during the past six years.

Camanche Gold Dredging Company entered the Camanche field late in 1923 with a Risdon dredger carrying 69 buckets of 4-cubic feet capacity each.

IRON.

Some small and unimportant bodies of iron ore have been noted in the county, and are estimated to contain a few thousand tons of ore.

Big Trees (Calaveras) Deposit is in the S½ of Sec. 32, T. 4 N., R. 14 E., a mile and a half north of Murphy and 10 miles from the railroad at Angels Camp. Owners: Domingo Rolleri, of Angels Camp, et al.

Some open cuts and a tunnel 75 feet long were run many years ago to prospect it. It is described as siliceous ore (limonite) on a hill 100 feet high and 300 feet wide, and extending some distance across country, but has not been closely examined.

Bibl: Cal. State Min. Bur. Bull. 38, p. 297. Unpublished field report by C. A. Waring.

Bonanza Deposit is an undeveloped prospect, on the old Bonanza Mine 7 miles southeast of Mokelumne Hill.

The Detert Deposit (Monarch) in Sec. 11, T. 4 N., R. 10 E., a mile and a half north of Valley Spring, is a limonite hill capping. Only assessment work has been done in late years. Assays 55% to 60% metallic iron.

Bibl: State Mineralogist's Report VIII, p. 156; Cal. State Min. Bur. Bull. 38, p. 297; U. S. Geol. Survey Geologic Folio Nos. 3, 5, 11.

There is limonite ore one-half mile north of the Esmeralda quartz mine near Indian Creek, in the Calaveras formation. An assay of this ore showed 56.9% metallic iron.

Bibl: U. S. Geol. Survey Geologic Folios 3, 5, 11.

MOLYBDENITE.

Samples of molybdenite ore occuring in coarse flakes in an acid dike rock have been found in the eastern part of the county near Bloods. This is a rough, mountainous district covered by granite lying at an elevation of 8000 to 10,000 feet and prospectors have failed to find a second time the exact place from which the samples came.

MANGANESE.

A few manganese prospects have been noted in the county. Bulletin 76 mentions prospects of manganese oxide on the *Fortner Ranch*, 2 miles northeast of San Andreas, and the *Manilla Manganese Property*, in Sec. 27, T. 4 N., R. 11 E., six miles southeast of Valley Springs. A sample of this indicated it was low grade. Other prospects have been noted, but they are quite a distance from the railroad and have not been developed.

Bibl: Cal. State Min. Bur., Bull. 76, p. 31.

PLATINUM GROUP METALS.

A small recovery of placer platinum has been made from dredging operations along Calaveras River in the Jenny Lind district, and along Mokelumne River in the Camanche district. The producers, some of them no longer in operation, were Calaveras Dredging Company, El Oro Dredging Company, and Ivy L. Borden's Isabel Dredge, in the Jenny Lind district; and American Dredging Company in Camanche district. Production has lately dropped to 20 fine ounces or less annually.

Bibl: Cal. State Min. Bur. Bull. 85, pp. 31 to 33.

STRUCTURAL AND INDUSTRIAL MINERALS.

Calaveras contains large deposits of the industrial and structural minerals and many prospects of less common ones. The remoteness of many deposits from railroad lines, and the rather high freight rates which must be charged on the railroads has retarded exploitation of numerous properties. Nevertheless, more work of this kind is being done in the county each year, as witnessed by the recent opening of a greenstone property at Angels Camp, soapstone and vein quartz deposits at Carson Hill and the proposed erection of a Portland cement plant at Kentucky House. There are numerous undeveloped deposits of chrysotile asbestos, clay and ocher, marble, limestone, miscellaneous stone, roofing slate, white quartz, hard and soft volcanic ash, sandstone and other minerals used in building. A garnet prospect is reported, of good quality but undetermined extent, in the higher and inaccessible mountains on the east side of the county. Small deposits of chromite were mined during the late war. Rock crystal of larger size and better quality than found elsewhere has been produced commercially and opals of possible value are now being tested.

The following notes are intended to give a summary of these different resources. The time allotted for the preparation of the notes and the unusually stormy spring of 1925, prevented as much field work as was desired, but it is believed the subject has been covered in sufficient detail to serve the purpose of a preliminary guide, which will be amplified in a new bulletin on commercial industrial and structural minerals which the State Mining Bureau plans to prepare.

ASBESTOS.

Chrysotile asbestos of good quality occurs in Secs. 15, 16, 21, T. 21 N., R. 13 E., 7 miles from Copperopolis on the west side of North Fork of Stanislaus River. Efforts have been made since 1904 by *Asbestos*

Producing Company of California, American Asbestos and Manufacturing Company, American Asbestos Products Company, California Asbestos Company and Pacific Asebestos Corporation to exploit the asbestos, and considerable money has been spent, but there has been no commercial production to date. The extent of development work, and the asbestos prospects revealed by it, were described by the writer in our monthly, MINING IN CALIFORNIA, March, 1922. As stock of this bulletin is nearly exhausted, and as little has been done at the property since it was written, excerpts are given herewith.

> "One thousand feet south of the north end of the property No. 3 adit has been driven north in the serpentine about 170 feet. This shows a good prospect of chrysotile asbestos. Between 200 and 300 feet south of this portal is a shaft now open about 30 feet deep on the west side of the asbestos zone, and 300 feet east of it is a cut and tunnel 40 feet long. Both these show good asbestos prospects. Fifteen hundred feet south of these and 250 feet lower on the side of the river canyon, No. 1 adit has been driven about 250 feet; it is in harder serpentine which does not carry asbestos in the same amount as in the upper workings, although the fiber is in evidence on the surface between the workings. No. 2 adit is 80 feet long and a little above No. 1.
>
> "The upper workings mentioned above indicate a promising asbestos-bearing area about 500 feet long and 300 feet wide. The company's engineer, W. J. Woolsey, claims that they have an area 2500 feet long north and south by 1000 feet east and west which is indicated to carry enough asbestos to pay a profit, but this was not all covered by the writer. Mill runs made some years ago are said to have shown about five per cent fiber in rock taken from No. 3 adit. The fiber ranges up to one inch in length and appears to be of good quality.
>
> "Improvements and equipment include a concrete-covered camp building, ammonia refrigeration plant, 3-drill air compressor, three air drills, 2500 feet of air pipe line, blacksmith shop, four ore cars, 600 feet of track, electric motors of a total of 200 horse power, three miles of 17,000-volt electric line and some asbestos milling and screening machinery from a small mill formerly used experimentally. The company hopes to have a new mill in operation during the present summer, but have not yet begun construction. The property is seven miles from Copperopolis and about the same distance from the railroad at Chinese, which could be reached by bridging the river and repairing an old stage road."

An assessment of $10 a share was levied October 4, 1924, upon the stock of Pacific Asbestos Corporation, which is the last of these companies to work on the property. Ownership of the 610 acres in the project has been divided among several persons and corporations, from whom the last-named company has been holding the land partly under option, and partly under mortgage. On January 26, 1925, California Asbestos Company obtained judgment and decree of foreclosure against J. A. Voorhees, Lillian M. Voorhees, American Asbestos Products Company and Pacific Asbestos Corporation and 160 acres of the holdings were sold February 27, 1925, to Newton Todd of Long Beach. The land sold is NE¼ of SE¼ Sec. 16; NW¼ of SE¼ and SW¼ of NE¼ Sec. 16; and S½ of SW¼ of NW¼ and W½ of NW¼ of SW¼ Sec. 15, all in T. 1 N., R. 13 E., M. D. B. & M., known as Asbestos & Reynolds Ferry Placer Mines. Pacific Asbestos Corporation has an office at 1798 Broadway, San Francisco.

Turner & Lloyd prospect is about three-fourths mile southeast of the old Nassau copper mine and one-fourth mile from the Copperopolis-Angels Camp road at a distance of nine miles from Angels Camp, the nearest railroad station, or 15 miles from Milton. There are 80 acres on which good prospects of short-fiber chrysotile asbestos have been found in a number of places, but only assessment work has been done. An old road connects the prospect with the main road. Dr. H. C. Turner and Jarvis Lloyd of San Andreas are the owners.

BARITE.

Barite often occurs as a gangue mineral in the copper mines of the state and was so found at the *Napoleon Copper Mine*, the *Satellite*

Copper Mine and no doubt others. Some unsuccessful experiments were made upon samples from the Napoleon Mine in an effort to produce barite of sufficient purity for commercial use.

CEMENT.

The probability of the founding of an important new industry which will mean a great deal for the county is indicated in preliminary work and property transfers already completed. William MacNider has been working for two years or more on plans for the financing and establishment of a cement plant at Kentucky House to utilize limestone deposits there and elsewhere in the county. These plans include a branch railroad from Valley Spring for which the original survey had to be changed on account of Stockton flood control project on Calaveras River. A second survey for the railroad has just been completed (May 1, 1925). Preliminary drilling and tests of the Kentucky House deposits have been about finished, and plans for the plant are now being considered.

Late in March, 1925, Wm. MacNider, Chas. P. Snyder, Geo. B. Poore, Lloyd Baldwin and Robt. Duncan deeded to Calaveras Cement Company, several options and contracts, and parcels of land containing limestone deposits in the vicinities of Kentucky House, Cave City and on O'Neill Creek. William Wallace Means and other easterners are reported to be interested in the new company, which has a staff at San Andreas in connection with the work.

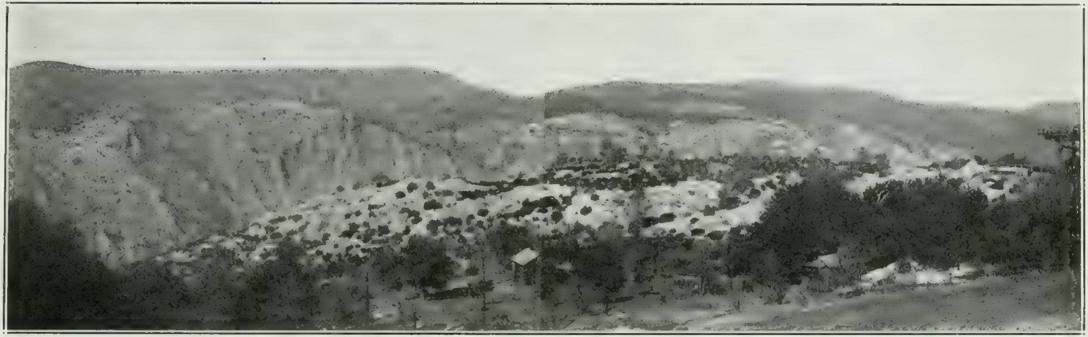
CHROMITE.

During the World War, 12 or more properties in this county produced chromite, but none of them were very large producers and they have all been idle since 1918. For details regarding properties, the reader should refer to Bulletin No. 76, 'Manganese and Chromium in California,' pp. 121–123, 216–217. The chromite resources of this county are not of as much importance as in other counties, the total recorded production having been about 8000 tons, of which practically all was produced between 1915 and 1918.

The following properties are of record in Bulletin 76:

SYNOPSIS OF CHROMITE PROPERTIES.

Name of property	Owner or operator	Post-office address of owner or operator	Section, township and range	Length of haul, railroad shipping point
Burnham Ranch	Burnham Bros.	Copperopolis	--–1–13	16 miles, Milton.
Campbell	Mineral Res. Corp.		--–1–13	16 miles, Milton.
Clary and Langford	Nassau Copper Mining Company	Angels Camp	10–2–12	8 miles, Angels.
Davis	Jno. Davis	Copperopolis	14–2–12	15 miles, Milton.
Dean	S. P. Dean	Felix		Milton.
	Federal Ore Company	San Francisco		
Hinch	---- Hinch	Angels Camp	3–2–12	7 miles, Angels Camp.
Lowry	Geo. C. Lowry	Fosteria	23–5–10	4 miles, Valley Spring.
McFaul	J. McFaul	Angels Camp		Milton.
Peri	F. Peri	Copperopolis	6–1–13	Milton.
True Blue	Mrs. E. S. Madrid	Angels Camp		10 miles, Angels Camp.
Vogelgesang	D. D. Vogelsang	Valley Spring		5 miles, Valley Spring.
Ward	Geo. Ward	Fosteria		Valley Spring.



Limestone Cliff on Stanislaus River, Calaveras and Tuolumne counties. The cliffs in the background are on the Calaveras County side. Looking northwest from Columbia Marble Quarry.

CLAY.

Preliminary Report No. 7, pp. 43–44 mentions:

W. A. Houts, 202 Balboa Bldg., S. F., deposit at Burson.

Penn Mining Co. A. P. Busey, manager. Deposit at Campo Seco; clay beds overlie copper ore. Used in copper smelter.

Valley Spring Clay Pit, one-fourth mile northwest of Valley Spring station. Pottery clay (variegated, red burning) is worked and shipped to California Pottery Company at San Francisco. Operation of this pit continues, and the company has added considerable equipment. The property is served by a spur track from the Southern Pacific branch line.

The Ione formation, carrying white and light-colored siliceous clay, traverses the county from Camanche southward past Milton. This series of beds is being extensively worked in Amador County, and should the demand for this type of clay warrant, no doubt that part of the Ione beds adjacent to the Valley Spring railroad branch could supply it.

The Valley Spring district and adjoining country from Mokelumne River to Milton is an area in which may be found a variety of clays, volcanic tuffs and mixtures of the two with some beds of the tuffs showing the sorting action of water probably due to their transportation by slowly-moving streams, or stratification in shore waters. Some of the beds show the character of clay of the 'rock soap' type, as indicated in a sample taken on the Field Ranch, five miles from Valley Spring on the Fosteria road. The outcrop there is small, and probably not of commercial grade. Parts of this area adjacent to Mokelumne River east of Lancha Plana will be affected by the water supply project of the East Bay Utilities District, which is said to have already purchased land there.

LIMESTONE.

The limestone resources of Calaveras County are extensive but undeveloped. Deposits occur in a belt of Calaveras (Carboniferous) formations with strike northwest passing a mile west of San Andreas; and the largest limestone bodies in this belt are at and south of Kentucky House, from two to four miles south of San Andreas. Another large deposit, which has been mapped as having a length of two and a half miles in a northwesterly direction, passes through Cave City. More immense than these, however, and rivalling if not exceeding in size any other limestone deposits in the state, is the area of limestone and marble extending from Sonora in Tuolumne County to a point three miles northwest of Murphys in Calaveras County. The North Fork of Stanislaus River has cut a canyon 1000 feet deep through this limestone and traverses it for a distance of three and one-fourth miles. Much of the limestone in the county has been changed to marble due to the pressure and folding exerted upon the rocks of the Calaveras formation, which everywhere show schistose structure.

There is no limestone production now in the county except the small amount used at the smelter of Calaveras Copper Company at Copperopolis. An important development is promised in this line by the projected erection of a Portland cement plant near Kentucky House. (*See* Cement.)

MARBLE.

As mentioned above, much of the limestone in the county has been altered to marble. The large body extending from Tuolumne County (where it is quarried at the Columbia and Bell Marble Quarries) covers extensive areas near Murphy, Vallecito and Douglas Flat. Several attempts have been made to open quarries, among which may be noted the *Angels Marble Quarry* where the California-American Marble Company installed equipment and made a few shipments; and the *Eagle Marble Quarry*, a mile east of Vallecito, where the Eagle Marble Company made a small production, and later Eagle Marble and Lime Company proposed to operate, but have done little, although still alive as a company. None of the other deposits mentioned under limestone have been worked because of their distance from railroads.

The deposit near Vallecito and Murphy contains two very interesting caves known as the Moaning Cave and Mercers Cave, which are visited by many sightseers.

MINERAL PAINT.

On the *Holmes Ranch*, at Campo Seco, there is a body of decomposed slate, stained by iron oxide, which has proved to produce a durable paint.

Bibl: State Mineralogist's Report XIV, p. 130.

Late Ocher Mine, one-half mile west of Valley Spring, produced several carloads of ocher 25 to 30 years ago, but has been idle lately. The ocher varied in color from yellow to dark red.

Bibl: Cal. State Min. Bur. Bull. 38, p. 338.

D. F. Rhoden of Valley Spring reported to this Bureau an ocher deposit three miles from that place. Samples of brown and yellow ocher were submitted, but the deposit has not been visited so its extent and character are not known to the Bureau.

In this connection, refer also to Iron, deposits of which mentioned herein, may be suitable for paint in some cases.

MINERAL WATER.

Mok-Hill Mineral Springs. Zumwalt, Dahl, and Zumwalt of Mokelumne Hill continue the operation of a small bottling plant at that place. The water of this spring, which has been well known since the early days, is bottled and lightly carbonated. The water carries magnesium especially, and calcium and sodium to a less extent. It is remarkably clear, standing for years without murkiness.

Bibl: State Mineralogist's Report XIV, p. 130.

Valley Spring Mineral Well. This well is near Valley Spring and is 150 feet deep. The water is rich in chlorides and carbonates.

Bibl: State Mineralogist's Report XIV, p. 130.

MISCELLANEOUS STONE.

Angels Greenstone Company. (Formerly Pacific Rock Granule Co.) Main office 201 Nevin Avenue, Richmond. C. S. Renwick, manager. Plant at Tryon Mine, adjoining Angels Camp.

Green amphibolite schist, locally called greenstone, is mined from the 200-foot level of the Tryon Mine and hoisted. The primary crusher reduces it to one and one-fourth inch size, and it is screened and most of the dust removed, after which the rock passes through a system of rolls and screens, and the rest of the dust is removed by air suction.

The products are stucco dash, passing 3-mesh and retained on 4-mesh; roofing rock, passing one-half inch; retained on 4-mesh; roofing granules, running about 25% of 14-mesh, 50% of 20-mesh and 25% of 40-mesh. A large part of the final product is too fine for the above uses, and the finding of a market for it is a problem. A screen analysis of this product or dust, made at the time of the writer's visit, follows:

Weight of sample	317.5 grams	
Stops on 80-mesh	16.0 grams	(includes few coarse pieces)
Through 80-mesh, stops on 100-mesh	none	
Through 100-mesh, stops on 200-mesh	14.4 grams	
Through 200-mesh	272.7 grams	
Loss of fine dust by air floating	14.4 grams	

A chemical analysis of amphibolite schist from California by Hillebrand[1] shows:

SiO_2	45.56%	
Al_2O_3	14.15%	
FeO	9.83%	
Fe_2O_3	1.20%	
FeS_2	7.86%	
MgO	6.76%	(probably present as $MgCO_3$)
CaO	2.30%	(probably present as $CaCO_3$)
K_2O	1.18%	
Na_2O	1.57%	
CO_2	3.04%	
TiO_2	1.11%	
H_2O (above 100° C)	4.84%	

Traces Cu_2S, MnO, BaO, P_2O_5, SO_3.

This probably represents very closly the composition of the product here.

Anyone in a position to utilize such a finely ground product could probably get an advantageous price. A freight rate of less than $3 a ton to San Francisco could be had.

This plant employes four men and has ample capacity to fill orders.

Hesperides Mining Co. plant and office were at Wallace, Calaveras County. H. L. Patterson, secretary.

The company erected a large plant at Wallace as mentioned in our MINING IN CALIFORNIA for January, 1924, p. 7. They produce quite a large amount of crushed rock, gravel and sand. An ancient gravel deposit containing a little gold, was worked. The crushed rock and sand were used in large quantity for concrete highway construction during 1924, but when they began taking material from a second section of the deposit the rock was found to be too soft and rotten for use in concrete. The plant shut down in the latter part of 1924 and was being junked in March, 1925. It was said to have cost close to $200,000. It was laid out in such a way that there was no storage provision between the steam shovel and crusher and the entire plant had to be operated as a unit. Little gold was recovered.

---

[1] U. S. Geol. Survey, 14th Report Vol. 4, Pt. 2, p. 259.

OPALS.

Opals were found in the early days in some of the old drift mines at Mokelumne Hill, and caused considerable excitement until it was determined that they were not of gem quality.

More recently Robert Irvine of Mokelumne Hill has found a deposit of opals occurring near the surface in a pink clay seam enclosed in andesite tuff and breccia. The stones are each enclosed in a shell of pure white silica, evidently the result of alteration of the opal itself, and many of them are of good size. Promising results have been had during the past month by a jewelry firm that has cut some of these opals and further tests may reveal stones with sufficient play of colors to be classed as gems.

It is possible that these opals may be distributed more widely than heretofore realized, as the writer has noted the occurrence of similar pink seams in the andesite tuff nearly a mile from the above deposit and several hundred feet lower. This andesite flow covers Stockton Hill, a long ridge running westward from Mokelumne Hill, and underlain by an ancient river channel which was mined extensively in years past.

QUARTZ.

White vein quartz for industrial uses has been produced during 1924 from the Iron Rock Mine at Carson Hill. Jim Oneto has lately been mining the quartz on contract, and shipping it out over the Sierra Railway of California whose tracks adjoin.

There are numerous other white quartz veins in the county, among which those in the Carson Hill district are nearest to railway transportation. This mineral commands such a low price that it can be profitably mined and shipped only when quite near the railroad.

ROCK CRYSTAL.

Green Mountain Mine is a mile and a half south of Mokelumne Hill in Chili Gulch. It has produced probably the largest quartz crystals ever found. J. J. McSorley who has been in charge of the property for many years, states the crystals were found loose in a sand bed on a bar of the buried river channel while working it as a drift mine. This was one of the earlier channels, filled mostly with quartz cobbles and quartz sand. McSorley states the largest rock crystal found weighed over a ton,[1] and there were many large crystals containing a great deal of clear unshattered quartz, indicating the crystals had not traveled far from their source. The 'root' end of a crystal is generally milky, or translucent. If these crystals formed in an open fissure or vein, as many suppose, this has not yet been proved here, as no such vein has been encountered in the workings. Between 1897 and the close of the late war, 22 tons of crystals were mined and sold. One carload of boxed crystals was shipped to New York, and for many years the market was supplied from this lot by Tiffany and Company.

Rock crystal in large sizes without flaws is rare, and those from this property have been used in cutting the largest perfect spheres ever made from quartz, and in making large lenses and prisms for telescopes and spectroscopes, lenses for cameras, interferometers and other optical instruments. McSorley states a sphere 14 inches in diameter was cut from one of these crystals, and Kunz[1] mentions two spheres 7½ inches in diameter, which were not entirely flawless, and one perfect sphere 5½ inches in diameter, cut from these crystals. Rock crystal permits the passage of many of the light rays of short wave-length, to which a glass lens is opaque, and is utilized where it is desired to use or study ultra-violet and similar rays. Quartz spheres are also much sought after by 'crystal gazers' and the crystals are in demand for jewelry and bric-a-brac.

---

[1] Mr. Blay of Mokelumne Hill, who helped prepare the largest crystal for shipment, states it was about six feet long and weighed 2800 pounds.

The old tunnel from which the crystals were produced is caved and inaccessible. On the adjoining *Green Mountain Extension* claim, on the same channel, McSorley is now driving a new adit to develop an unworked section of the gravel deposit, where he hopes also to find more crystals. This adit will be 700 feet long and will be completed this summer.

Miners acquainted with former drift mining operations near Mokelumne Hill state that a great many quartz crystals were thrown away during the operation of mines now worked out and deserted. These crystals were spoiled and lost by going over the dumps.

SLATE.

Two extensive belts of Mariposa (Jurassic) black slate traverse the county, and contain material of grades suitable for roofing and other purposes. The westerly belt passes through Salt Spring Valley and northwestward to Valley Spring. Some work has been done on this slate about 10 miles east of Milton, but this was years ago. The other slate belt passes west of Carson Hill and Angels Camp, in a northwesterly direction.

California slate, in common with other natural building stones, has suffered from the competition of artificial products, and this competition has been especially severe in the case of roofing slate, as there are so many substitutes which are aggressively advertised by their makers. Due to distance from main-line railroads, the slate of Calaveras County would be handicapped in competition with that from other counties.

SANDSTONE.

Two small sandstone quarries were opened years ago, one on the *Late Ranch*, a mile south of Valley Spring, where some white sandstone was quarried; the other on the Wildermuth property, three miles northeast of Valley Spring, where a soft gray stone was worked. These quarries, in common with most others in the state, have been idle in later years because of the competition of cement.

SOAPSTONE AND TALC.

A sample lot of several tons of soapstone was shipped in April, 1925, from the *John Peirano property* near Carson Hill.

There are other deposits of soapstone and talc of good grade in the county, notably on the Aime Laidet property, six miles east of Mokelumne Hill, where a bed of good grade talc three feet wide is accompanied by a wide body of soapstone. This is difficult of access and too far from present railroads to be exploited. Other deposits have been noted two and a half miles west of Murphys, where some production was used locally, and a mile southwest of Vallecito, where there in an off-color deposit of soapstone and talc. Distance from railroad and the relatively high freight rates that necessarily prevail on the short-line railroads serving this district, have held back the development of such commercial minerals, which at present are being mined and shipped from deposits elsewhere that are more advantageously situated.

---

[1] Kunz, G. F., Gems and jewelers' materials of California: Cal. State Min. Bur. Bull. 37, pp. 65–66, 1905.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

MERCED COUNTY.

Introduction.

Merced County was created on April 19, 1855, from the western portion of Mariposa County. Originally its western boundary extended from the present northwest corner of the county southeasterly along the crest of the Coast Range almost to the Sixth Standard Parallel South, the southern boundary of Kings County, and its original area was close to three times its present area. The following year Merced County was reduced to approximately its present size by the organization of Fresno County on the south, the dividing line being practically the same as it is today.

Geography and Geology.

The county is situated near the geographical center of the state. It is bounded on the north by Stanislaus County, on the east by Mariposa, on the south by Madera and Fresno, and on the west by Santa Clara and San Benito counties. It has an area of 1995 square miles and supports a population of 24,579 (1920 census). Most of the land is cultivated, and much of it is irrigated, there being extensive irrigation systems covering the valley lands.

Merced is essentially an agricultural county, yet it stood thirty-eighth among the 58 counties of the state in the value of its mineral production in 1923, ranking ahead of Sonoma, Monterey, El Dorado, Siskiyou, Mariposa, San Luis Obispo, Mendocino, Mono, and a dozen others.

The greater part of the county lies within the San Joaquin Valley, and is composed of unconsolidated sands, gravels, and clays of Quaternary age. Along the eastern edge of the county there is a narrow belt of Tertiary formations, represented mainly by clays, shale, and massive sandstone. On the western side of the county Cretaceous sandstones and shales appear, and as the western boundary of the county, near the summit of the Coast Range, is approached Franciscan rocks of Jurassic age are exclusively in evidence. These consist mainly of slates, cherts, sandstones, schists, and serpentine.

Mineral Resources.

Both metallic and non-metallic minerals have been found and produced in Merced County. Among the former are gold, platinum, silver, copper, and a few pounds of lead. Crushed rock, gravel, sand, clay, and clay products are the chief non-metallics. In addition to these the occurrence of a few other minerals has been noted, such as cinnabar (quicksilver), stibnite (antimony), barite, calcite, diatomaceous earth, magnesite, asbestos, manganese, coal, and soda niter, but for the most part these are entirely undeveloped and probably most of them do not occur in marketable quantities.

Gold dredging operations on the Merced River in the vicinity of Snelling, which ceased in 1919, account for the major portion of gold, platinum and silver produced. The small output of copper years ago all came from one locality, the extreme southwest corner of the county in Township 13 S., Range 9 E.

Miscellaneous stone, including crushed rock, gravel, and sand, and brick and tile, are at the present time the principal mineral products. The establishment of a cement plant at Merced is under way, and cement will no doubt be added to the list within the near future. Structural materials of this nature will contribute almost exclusively to the future mineral output of the county.

The following table gives the total recorded mineral output of the county from 1880 to 1923, inclusive:

MERCED COUNTY, 1880-1923.

Year	Gold, value	Silver, value	Miscellaneous stone, value	Brick		Miscellaneous and unapportioned		
				M.	Value	Amount	Value	Substance
1880	$17,515							
1881	1,500							
1882	10,000							
1883	10,000							
1884	6,500							
1885	10,000							
1886	7,000							
1887	10,767	$5						
1888	10,000							
1889	4,843							
1890	2,000	59						
1891	1,728	17						
1892	445							
1893								
1894	763							
1895	1,500							
1896	1,250							
1897								
1898								
1899								
1900	(1)							
1901	(1)					79,071 lbs.	$12,453	Copper.
1902						14,400 lbs.	1,656	Copper.
1903	(1)					6,000 lbs.	780	Copper.
1904	(1)					8,900 lbs.	1,135	Copper.
1905	(1)			600	$3,500			
1906				650	6,000			
1907	822	10		1,250	12,500			
1908	[2]182,970	[2]1,196		700	6,300		106	Lead and copper.
1909	[2]228,492	[2]572		700	6,300		18,264	Unapportioned.
1910	(1)	(1)	$64,764	700	6,300			
1911	(1)	(1)	49,548					
1912	(1)	(1)	45,000					
1913	[4]2,255	[4]92	30,000			19,240 lbs.	2,982	Copper.
1914	[2]111,361	[2]340						
1915	(3)	(3)				690 lbs.	32	Lead.
							94,000	Other minerals.
1916	(3)	(3)				90 tons	720	Magnesite.
							80,810	Gold, platinum, silver
1917	(3)	(3)	70,500				76,616	Gold, platinum, silver
1918	41,089	254	32,500				1,006	Other minerals.
1919	(1)	(1)	40,350					
1920			24,800					
1921	3,163	87	30,300					
1922	(3)	(3)	88,110				69,469	Building tile, gold and silver.
1923	(3)	(3)	134,063	(3)	(3)		101,567	Brick, building tile, gold and silver.
Totals	[3]$665,963	[3]$2,632	$609,935	4,600	$40,900		$461,596	

[1] Included with Stanislaus County production.
[2] Includes Stanislaus County production.
[3] See under 'Unapportioned.'
[4] Dredge output included under Stanislaus County.

In compiling the following data on the mineral resources of Merced County, an endeavor has been made to mention all those that have come to the attention of the State Mining Bureau, whether commercial or not. Only those properties at which there has been some recent development or production are described in detail; such notes as have been published concerning the other deposits will be found by referring to the bibliography.

ANTIMONY.

Fine specimens of stibnite, the common ore of antimony, have come from the McLeod mining district, which was organized in 1872. It embraces the summit of the Mount Diablo Range and covers portions of Merced, San Benito, and Santa Clara counties, in Townships 11 and 12 S., Range 7 E. Antimony Peak in Sec. 32, T. 11 S., R. 7 E., is characterized by its many veins of antimony. Most of the early production, however, came from mines located on the San Benito County side of the line. There has been no recent activity, but the district holds out possibilities, should the price of the metal increase enough to justify mining.

Bibl: State Mineralogist's Reports VIII, p. 485; X, pp. 515–517; XII, pp. 22–23. State Min. Bur. Bull. 91, p. 29.

ASBESTOS.

Asbestos is said to occur in Townships 7 and 8 S., Range 16 E., near the Mariposa County line. The deposits are undeveloped and of doubtful value.

Bibl: State Mineralogist's Report XIV, p. 179.

BARITE.

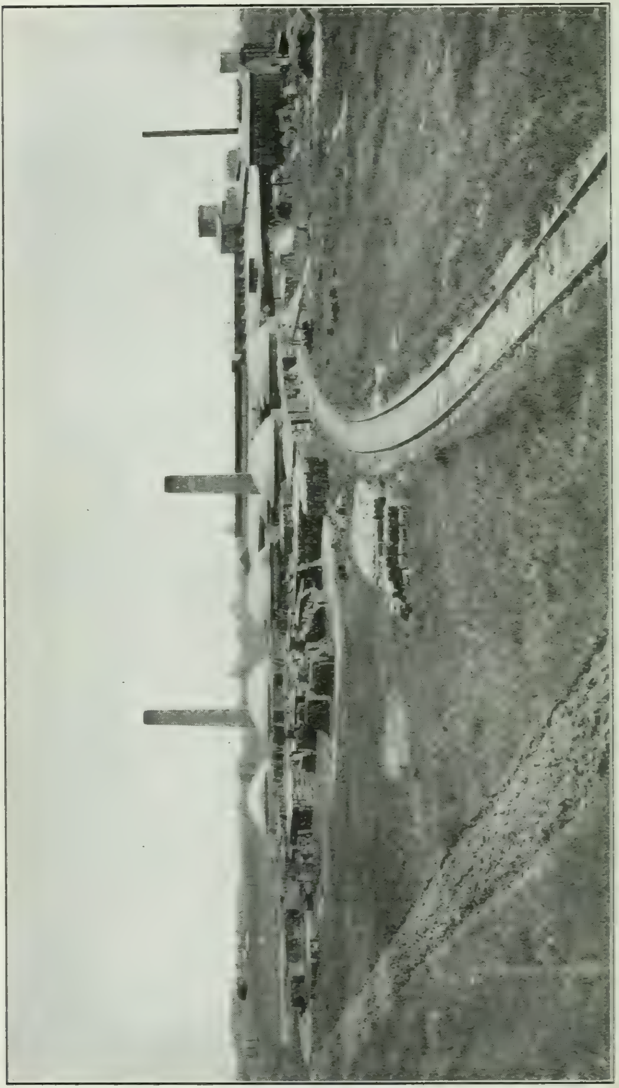
Barite, mixed with triboluminescent sphalerite, has been found in the vicinity of Merced Falls. The occurrence is of mineralogical interest only.

Bibl: State Mining Bur. Bull. 91, p. 263.

BRICK AND TILE.

The California Pottery Co. F. A. Costallo, president; P. G. Lingren, secretary; home office, Merced, California; M. C. Alsip, plant superintendent. This company has a large plant at Creegan Siding, two miles south of Merced, and is producing hollow building tile, roofing tile and face brick. The plant was erected in 1921, and production began in January, 1922. Fire clay is procured at Valley Springs, Calaveras County, and some buff-burning clays from Lincoln, Placer County. About 40% of the clay used is shipped in, and 60% is dug at the plant on the company's property, which contains 53 acres. The local clay is a somewhat sandy loam, occurring under the hardpan strata. It is dug and conveyed to the plant with Fresno scrapers.

A Stevens and Raymond dry pan does the grinding, the stiff mud process being used. A No. 290 American Clay Company machine is used for making brick and hollow tile, and a No. 233 machine of the same make for the roofing tile; both being of the auger type. From the machines the green brick and tile pass to a traveling belt. They are taken from the belt, stacked on cars and then run to the dryer. This is a 20-track American Clay Company dryer, using waste heat from the kilns. Drying takes about 36 hours.



Plant of The California Pottery Company, Merced, California.

Photo by courtesy of the company.

There is a battery of eight Beehive kilns, down-draft type, each of 30 feet inside diameter. Crude oil of 14° gravity, atomized by steam, is used for fuel. The burn takes about 98 hours, and the finish temperature approximates 2100° F. (cone .01). A department to make hand-molded products is contemplated. A Southern Pacific spur track runs to the plant, and most shipments are in car lots. Electric power, furnished by the San Joaquin Light and Power Company, is used throughout, 290 horsepower being required. The capacity of the plant is 50 tons per day, and 35 men are employed.

CALCITE.

The mineral calcite, said to be strontium-bearing, is reported to occur at Delhi, but there are no limestone (calcite) deposits of commercial value known within the county.

Bibl: State Mining Bur. Bull. 91, p. 128.

CEMENT.

Yosemite Portland Cement Corporation. A. Emory Wishon, president; W. A. Sutherland, vice president; Murray Bourne, secretary-treasurer. This company owns a plant site of 145 acres located about two miles north of Merced, upon which they have a cement plant of 2000-barrel initial capacity, about one-third completed. The plant has direct connections with the Southern Pacific and Yosemite Valley railroads, and the Santa Fe is preparing to build a spur track to the mill. The plans call for a mill of reinforced concrete and steel construction, using what is known as the 'straight-line wet process.' It will contain three kilns, already on the ground, 160′ long and 8′ in diameter. The finished cement is to be stored in six reinforced concrete 'silos,' each 30′ in diameter and 90′ high, having a capacity of 90,000 barrels. Electric power, furnished by the San Joaquin Light and Power Corporation, will be used throughout. Water will be obtained from deep wells on the plant site and from the Merced River at the quarry site at Jenkins Hill, Mariposa County. The corporation has acquired approximately 1000 acres at the latter point containing immense deposits of high-grade limestone adjacent to the Yosemite Valley Railroad. The limestone deposits are in Secs. 7 and 8, T. 3 N., R. 19 E., at an elevation of 1340 feet at the railroad. Large open-face quarrying operations will be possible, with steam-shovel loading and spur-track transportation to the quarry crusher plant. An innovation in the crushing department is the plan to reduce the rock from quarry size to about $\frac{3}{4}$ inch in one operation, using a giant Williams mill of special design for the work. The distance from the quarries to the mill is approximately 63 miles. The other principal raw material required is clay. This will be mined at the mill site where extensive deposits of suitable clay have been developed.

When the Yosemite Portland Cement Corporation's plant is completed there will be a total of eleven cement mills in California.

CLAY.

No deposits of high-grade white-burning clays are known, and up to the present only small amounts of low-grade clay have been utilized.

Site of cement plant of Yosemite Portland Cement Corporation, Merced, California.

Photo by courtesy of the company.

Clay that can be used in the manufacture of common brick is found in the vicinity of Merced. During the period from 1905 to 1910 the Merced Brickyards produced a considerable quantity of brick, but it has not been operated since that time.

M. Goldman, of Merced, is the owner of large land holdings in the eastern part of the county, and it has been reported in the past that white clay, suitable for the manufacture of pottery, occurs on this property in the vicinity of Merced Falls. The holdings have not been thoroughly prospected, but the investigations that were made failed in finding any high-grade clay; the material being apparently a silt deposit of indefinite composition, rather than a residual clay.

Clay deposits are mentioned also as occurring in T. 5 S., R. 14 E. Their character and value have not been determined.

A somewhat sandy loam, obtained on the property of *The California Pottery Company*, is used to the extent of 60% of the plant's requirements in the manufacture of roofing tile, building tile and brick.

The Yosemite Portland Cement Corporation plans to utilize the local clay found on its 145-acre plant site two miles north of Merced in the manufacture of cement.

It seems certain that the better grades of clay do not occur in abundance within the county, but low-grade clays are found and being used, and these probably occur in quantity sufficient for all local needs.

Bibl: State Mineralogist's Report XIV, p. 605; Preliminary Report No. 7, p. 64.

COAL.

Indications of coal have been found at a few points in the county; notably three miles northwest of Snelling, where in 1893 it was reported that a 3′ vein of lignite, similar to that at Ione, had been cut in boring a well. Other indications have been found south of Merced River, between it and Bear Creek, but nothing of commercial importance has so far been developed.

Bibl: State Mineralogist's Reports X, p. 331; XII, p. 58; XVII, p. 149.

COPPER.

Two copper properties have been described by name in early reports of the State Mining Bureau. The *Jose Copper Claim* was located in Sec. 4, T. 14 S., R. 9 E. Considerable development work was done here and some small bodies of chalcopyrite ore carrying good values in gold and silver were exposed.

The *Victor Bonanza Group* was located in Secs. 30 and 31, T. 13 S., R. 10 E., and in Secs. 14, 15, 16, 23, 24, and 25, T. 13 S., R. 9 E., 16 miles southwest of Dos Palos. A mineralized belt is found here extending for five or six miles and having a width of from 100 to 200 feet. Native copper and chalcopyrite occur in the croppings. Only a little development work has been done. The county is credited with a small production of copper during the years 1901, 1902, 1903, and 1904. There was an output of about 20,000 pounds again in 1913, the last year in which any activity was noted in the district.

In 1920 it was reported that *Mr. George Berg*, of Panoche, had discovered a deposit of copper ore assaying high in gold and silver, about

Portion of limestone deposit at Jenkins Hill, Mariposa County, owned by Yosemite Portland Cement Corporation, Merced, California.

Photo by courtesy of the company.

18 miles east of Chowchilla. Development work was started in May of that year, but the result of this work was not learned.

Bibl: State Mining Bur. Bull. No. 50, pp. 171–172. State Mineralogist's Reports XIV, p. 605; XVII, p. 149.

DIATOMACEOUS EARTH.

Extensive undeveloped deposits of diatomaceous earth are found in the hills bordering the west side of the valley from Ortigalita Creek southerly for six or eight miles.

The beds in this locality appear to be of excellent quality and they will doubtless be utilized at some future time.

Bibl: U. S. Geol. Survey Bull. 603, p. 211.

GOLD, SIVER AND PLATINUM.

Of the precious metals named above, gold has been produced in greater or less quantity for many years, and there is still a small annual yield.

The sands and gravels of nearly all the streams entering the county on its eastern side carry some gold. Production has come entirely from placer operations. The most important of these has been the gold dredging operations of the Yosemite Gold Dredging and Mining Company, formerly carried on at Snelling, on the Merced River. Silver and platinum have been a by-product. Since the discontinuance of dredging in 1919, the output has become almost negligible, now coming entirely from a few small individual operations carried on intermittently.

Bibl: State Mining Bur. Bull. 57; Bull. 85.

MAGNESITE.

Magnesite occurs near the line between Merced and Stanislaus counties in Sec. 32, T. 8 S., R. 7 E., and some shipments have been made by rail from Ingomar. This material originated, however, on the Stanislaus County side.

MANGANESE.

Briggs Mine. Mrs. Anna E. Briggs, Hollister, California, owner. This property is in the S$\frac{1}{2}$ of the NW$\frac{1}{4}$ of Sec. 13, T. 13 S., R. 9 E., in the extreme southwestern corner of the county. It is 26 miles by road east of Tres Pinos, San Benito County, or it can be reached via Los Banos. The manganese outcrop is near the top of the ridge at an elevation of 3550′. An open cut has exposed a face of high-grade ore 3′ to 4′ wide. From indications, it appears that a good deposit might be opened up here, but in common with many other California occurrences, under normal conditions, its commercial value is doubtful. Should an emergency again occur, such as that during the world war, when high prices prevailed and specifications for commercial ore were lowered, this mine would undoubtedly become a producing property.

Bibl: State Mining Bur. Bull. 76, pp. 49–50; Bull. 91, p. 124.

PETROLEUM.

Petroleum, or mineral oil, is one of California's exceedingly valuable mineral resources. Large well-defined productive oil fields have been developed, mostly in the southern counties, and development work is constantly being caried on in an endeavor to discover new productive areas. The presence of favorable formations, seepages and other indications has been noted in a number of the central and northern counties, and drilling has been undertaken in many of them.

Merced County has not been overlooked in the wide search for petroleum. The prospecting for and production of this mineral product differs so radically, however, from other forms of mining that the oil industry is usually considered as a distinct and independent branch. For this reason no effort was made to include it in this report. All development operations are reported in current issues of 'Summary of Operations, California Oil Fields,' issued monthly by the Department of Petroleum and Gas of the State Mining Bureau.

Bibl: State Mining Bur. Bull. 89; U. S. Geol. Survey Bull. 603.

QUICKSILVER.

Cinnabar occurs in small amounts on the dividing line between Merced and San Benito counties, in the Stayton district. There has never been any production credited to Merced County.

Bibl: State Mining Bur. Bull. 78, p. 72; Bull. 91, p. 44.

SODA NITER.

The occurrence of soda niter (chili saltpeter) is of mineralogical interest only, as no important deposits are found in the state. The mineral has been identified in crusts with other sodium salts from Merced Bottom.

Bibl: State Mining Bur. Bull. 91, p. 245.

STONE INDUSTRY.

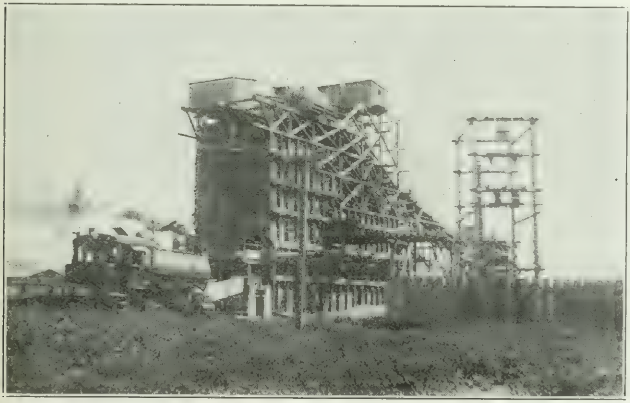
(Crushed rock, sand and gravel.)

Bent Bros., Inc. Arthur S. Bent, president; Wilbur Atkinson, secretary; home office, 418 South Pecan Street, Los Angeles. This company has a contract on the Exchequer dam, under construction on the Merced River above Merced Falls, and is operating a crushed rock, gravel and sand plant at a point locally called Bent's Pit on the Yosemite Valley Railroad five miles from Snelling and 13 miles east of Merced. The plant was started December 1, 1924. The deposit, which is on the Merced River, is owned by Robinson Brothers, the company taking the material on a royalty basis. It is dug with a Monigan steam drag-line machine with 2½-cubic yard bucket, loaded into self-dumping cars and transferred to the washing and sizing plant. Not much crushed rock is produced. The plant is of the ordinary type but with screens adjusted to give the sizes desired on the job. The following sizes are produced: ¼″ to 1¼″; 1¼″ to 2¾″; 2¾″ to 10″, though this size seldom runs over 4″ to 5″; and sand. Equipment includes two Vulcan and one Porter steam locomotives, oil-fired, and cars, all standard gauge. Electric power is used to operate the plant. At the time of visit it was being operated 18 hours per day, the production being 800 tons daily, and 45 men were employed. The dam is approximately 35% completed. When this job is finished the plant will probably be sold to some commercial producer or dismantled.

Los Banos Gravel Pit. Operations at this pit, near Los Banos, were discontinued by the former operators, C. E. and C. W. Wood, in the latter part of 1923, and it has since remained idle.

Marks Gravel Pit. Frank B. Marks, of Dos Palos, operates a gravel plant near the town of Dos Palos. The gravel is excavated with a drag-line scraper, operated by electric motor, delivered to the plant and screened to 2½-inch maximum size. Two men are employed.

Merced River Gravel Co.; address 531 W. Olive St., Turlock;, C. C. Fleshman, superintendent. This company has a gravel plant on the Drew Ranch on the Merced River, 1 mile east of Cressy Station on the Santa Fe Railroad. Operations began in March, 1924. The material is excavated by a 40-h.p. drag-line scraper driven by a gas engine, elevated to a revolving screen and sizes of ¾″ to 2″ made. The oversize is crushed in a jaw crusher for road material. A Best 45-h.p. tractor is used for the power plant. The capacity is 150 tons per day, and the product is loaded direct to trucks.



Crushed rock and gravel plant of Bent Bros., Inc., Bent's Pit, Merced County.

SAN JOAQUIN COUNTY.

By C. McK. LAIZURE, Mining Engineer.

Introduction.

San Joaquin County was one of the original counties created in 1850. The only important change in its boundaries since that time was when a triangular piece lying north of the Stanislaus River was annexed to Stanislaus County in 1860. Stockton has always been the county seat.

Geography and Geology.

The county lies mainly in the great valley of the same name in the central portion of the state. It is bounded on the north by Sacramento County, on the east by Amador, Calaveras, and Stanislaus. The latter county extends around and adjoins it on the south also. Contra Costa and Alameda counties lie west of it.

Stockton, the county seat and largest city, has water transportation facilities, as well as rail. The area of the county is 1448 square miles, and its population is 79,905 (1920 census). By far the greater part of its area is made up of farm lands; the so-called 'delta' region adjacent to Stockton being noted for its rich peat soil and heavy crops.

The most extensive geological formation exposed consists of unconsolidated sands, gravels and clays of Quaternary age, which compose the nearly level floor. The western edge of this formation follows closely the Southern Pacific Railroad line down the west side of the valley from Bethany to Vernalis. The corner of the county, southwest of the railroad, is composed of marine sandstone, and diatomaceous and clay shales of Tertiary and Cretaceous ages in the northern part. Its south half is rugged and broken, as the Franciscan rocks, typical of the Coast Range, including slates, cherts, limestones and sandstones with much schist and serpentine, are exclusively in evidence.

Unconsolidated sands, gravels and clays extend practically to the county line on the eastern side of the valley, the only other rocks exposed being two small areas of extrusive volcanic rocks, just east and north of Bellota.

Mineral Resources.

Comparatively few mineral substances are found in San Joaquin County, and of these the most important are non-metallic structural and industrial materials and natural gas. Gold, silver and platinum have been obtained by dredging in Mokelumne River. In 1923, the last year for which complete returns are available, the mineral production of the county was valued at $811,229, giving San Joaquin County twenty-sixth place in order of importance. Clay and clay products accounted for more than half the total.

In the following report on the county's mineral resources an endeavor has been made to mention all recorded mineral occurences of possible economic importance, whether developed or undeveloped. The total recorded output of the county (1885–1923) is given in the table herewith.

SAN JOAQUIN

Year	Brick		Natural gas	
	M.	Value	M. Cubic feet	Value
1885				
1886				
1894				$75,000
1895				100,000
1896	7,000	$35,000		85,157
1897	5,500	22,000		57,411
1898	6,500	34,000		57,289
1899	5,500	27,000	102,960	84,880
1900	2,000	20,000	27,612	19,862
1901	2,000	20,000		60,456
1902	[2]3,000	[2]18,000	81,481	67,868
1903	[2]4,000	[2]24,000	88,134	44,399
1904	7,500	45,000	106,437	47,635
1905	11,400	68,000	100,950	53,915
1906	7,500	49 500	103,450	55,115
1907	12,250	81,000	101,000	52,723
1908	28,412	189,560	60,903	49,194
1909	8,088	242,634	71,883	149,063
1910	8,744	212,538	313,392	159,451
1911	5,275	49,650		114,433
1912	6,128	64,874		145,166
1913	6,314	73,768	142,730	67,967
1914	5,793	82,890	154,872	25,900
1915	3,000	75,000	161,923	143,974
1916	10,189	158,722	182,441	141,605
1917	also tile	185,060	348,146	72,585
1918		305,475	202,453	60,405
1919		231,478	200,943	76,200
1920		(3)	200,433	74,957
1921		294,712	204,057	79,571
1922		(3)	199,389	62,454
1923		(3)	(3)	(3)
Totals		[3]$2,609,861		$2,284,635

[1] Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5,000 tons had been produced by that property. Annual amounts earlier than 1894 not separable.

[2] Estimated.

[3] See under 'Unapportioned'.

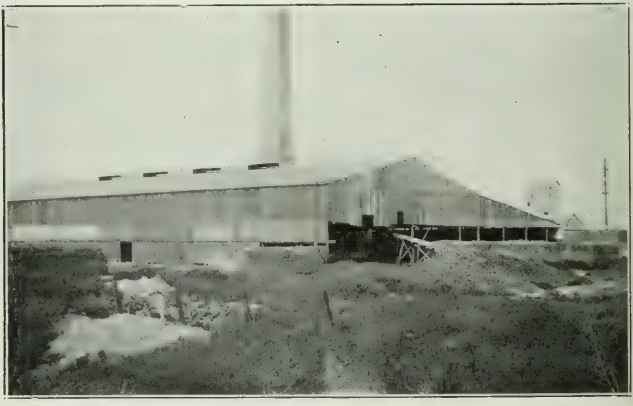
[4] Includes crushed rock, rubble, rip-rap, sand, gravel.

COUNTY, 1885-1923.

Manganese		Miscellaneous stone[4], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
(1)	------	------	------	$2,500	Gold.
------	------	------	------	------	
55	$550	------	275 tons	343	Pottery clay.
280	2,800	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	273 tons	2,730	Asphalt.
------	------	------	3 tons	90	Infusorial earth.
------	------	------	------	------	
------	------	$25,000	------	------	
------	------	------	------	------	
------	------	------	------	------	
60	1,080	------	2,000 tons	13,000	Clay.
------	------	------	------	214,835	Unapportioned, 1900-1909.
260	4,160	------	------	------	
------	------	------	25,510 tons	25,510	Clay.
------	------	------	------	------	
------	------	900	1,494 tons 3,000 tons	18,522 4,000	Clay. Glass sand.
150	1,500	19,440	------	200	Other minerals.
460	7,400	21,620	------	400	Other minerals.
6,493	115,460	53,075	------	------	
6,320	157,500	55,003	------	72	Other minerals.
4,281	117,709	47,085	------	71,299	Gold, platinum, silver.
343	10,274	59,510	------	71,538	Gold, platinum, silver.
(3)	------	63,077	------	333,068	Brick, gold, manganese, platinum, silver.
425	3,750	72,815	------	23,530	Other minerals.
(3)	(3)	(3)	------	314,269 96,672	Brick and clay. Manganese ore and miscellaneous stone.
(3)	(3)	260,597	------	472,858 77,774	Clay and clay products. Manganese ore and natural gas.
[3]19,127	$422,183	$678,122	------	$1,743,210	

BRICK AND TILE.

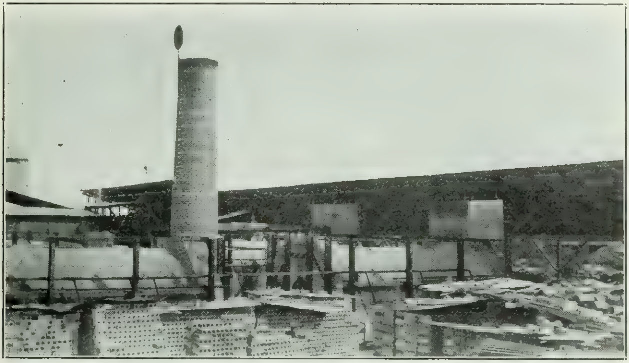
San Joaquin Brick Co. I. F. Stine, secretary-manager; Ernest Rosi, plant superintendent; home office, 33 South El Dorado Street, Stockton, California. The property consists of 60 acres, situated on Roberts Island about five miles from Stockton, where railroad connections are made. The clay used is excavated with a Marion steam shovel mounted on a barge. An S. S. S. automatic brick machine, using the soft mud process, is used. A continuous cable system takes the brick from the machine. They are dried on racks for three to five days, and then burned in a Hoffman continuous-type kiln for about 72 hours. Coal is used for fuel. Common red brick is the only product. The plant is operated from April to November only. It has a capacity of 60,000 bricks daily. Electric power for operating the machinery is supplied by the Pacific Gas and Electric Company, about 100 horsepower being required. Forty men are employed when operating.



Plant of Stockton Brick and Tile Co., Stockton, California.

Stockton Brick and Tile Co. Ralph Wilcox, president; Paul Weston, secretary; home office, 245 N. El Dorado Street, Stockton, California. This company's plant, which produces common red brick, is located on McKinley Avenue near the outskirts of the city, about one-half mile beyond the Municipal Baths. A Southern Pacific spur track runs to the plant. The plant was started in 1921. It has been closed down for overhauling of machinery, etc., since January, 1925, but operations are expected to begin again soon. The clay is dug under contract and delivered to the plant. The stiff mud process is used, the clay passing through a dry pan and then being elevated to the pug mill. From there it goes to the brick machine and cutter. The bricks are taken from the cutter belt, placed on cars and sent to the dryer. They are then burned in a Hoffman continuous type of kiln with a capacity of 450,000 brick, using coal for fuel. All machinery is operated by electric power. The plant has a capacity of 25,000 per day, and 20 men are employed when operating. G. Birtolini is plant superintendent.

Stockton Fire Brick Co. (Formerly Stockton Fire and Enamel Brick Co.) J. T. Roberts, president; Percy T. Claghorn, secretary; E. H. Horner, plant superintendent; address, P. O. Box 314, Stockton, California, or Rialto Building, San Francisco. The company's plant is on the line of the Southern Pacific Railroad at the foot of South California Street, Stockton. The output includes fire brick and other fire-clay products, such as runner brick and special hand-moulded forms. Raw clays from Placer and Amador counties are utilized. The stiff mud process is used, the materials passing through a dry pan and screens, then to a pug mill and auger brick machine, the entire process being continuous and automatic. From the brick machine the bricks are stacked on cars holding 380 each and dried in ovens heated by waste heat from the kilns. Drying takes approximately 30 hours. There are twelve round down-draft kilns, and four rectangular down-draft kilns used for burning runner brick used by steel mills and iron foundries. The kilns vary in capacity from 20,000 to 100,000 brick (40 to 800 tons). Fuel oil is used, and the bricks are burned from seven to eight days to a temperature of 2,500°. It takes the same amount of time to cool down a kiln as it does to burn the charge. The plant is equipped with up-to-date appliances, and all operations are subject to close technical control. There is an efficient testing laboratory, fully equipped with electrical and optical pyrometers for measuring high temperatures; including also a special conductometer for measuring the insulating qualities of materials at high temperatures. The result of this technical supervision has been a high quality output, which is shipped to Alaska, Honolulu, Japan, the Philippines, and South American markets, as well as meeting local demands. An average of 110 men are employed.



Stockton Fire Brick Company's Plant, Stockton, California. View showing special rectangular kilns for burning runner brick.

CLAY.

Low-grade clays suitable for the manufacture of common brick are produced at several points in the vicinity of Stockton, and there are doubtless extensive reserves of material of this class. High-grade pottery and fire-clay deposits are rare, if not entirely absent in San Joaquin County. Along the line between San Joaquin and Alameda counties in the vicinity of Tesla and Carnegie excellent fire clay was at one time produced, and utilized at the plant (now dismantled) of the Carnegie Brick and Pottery Company. The plant was in San Joaquin County, but the clay was obtained from the Tesla Coal Mine on the Alameda County side.

Bibl: State Mining Bur. Preliminary Report No. 7, pp. 94–95; Bull. No. 38, pp. 227–228; State Mineralogist's Report XIV, pp. 607–610.

Stockton Fire Brick Company's Plant, Stockton, California. View showing drying track floor.

COAL.

Prospecting was carried on at an early day in the western part of the county in the vicinity of Corral Hollow and along Lone Tree Creek. Some narrow veins of coal, mixed with shaly matter, were found, but none of them have ever been brought to a productive stage.

Bibl: State Mineralogist's Report X, p. 564.

DIATOMACEOUS EARTH.

A specimen of diatomacious earth from San Joaquin County was presented to the State Mining Bureau Museum years ago. It is probable that the deposit represented is of little importance, as it has never been exploited.

Bibl: State Mining Bureau Bull. 91, p. 92.

GLASS.

Western Stockton Glass Plant. This plant, which is located in the western outskirts of Stockton near the Municpal Baths, was erected by the Stockton Window Glass Company in 1901. It operated for a time, but was closed down in 1908. Litigation followed, and the ownership changed hands a number of times, with intermittent operations. In 1911 it was purchased by the Western States Gas and Electric Company, but was later sold by them. According to a legal notice posted at the plant, M. Davidson is now sole owner. On January 26, 1925, a contract of sale was given by Davidson to George Dare, and it is reported that the plant is again to be started up. It was last operated four years ago.

GOLD, SILVER AND PLATINUM.

Gold dredging operations account for the output of gold, silver and platinum credited to San Joaquin County. These operations have been carried on for the most part in the Mokelumne and Calaveras rivers, above the San Joaquin County line. The holdings of the *American Gold Dredging Company,* on Mokelumne River, however, included some land in San Joaquin County, and during the years 1918, 1919, and 1920 this area was dredged. As a result, San Joaquin County became a producer of the precious metals for a short period. There is little hope of further production except possibly a small amount obtained as a by-product from crushed rock, gravel and sand plants that may be operated in the future in this district.

GYPSUM.

Gypsum in the form of selenite has been found near Vernalis. The occurrence is probably of no economic importance.

Bibl: State Mining Bur. Bull. 91, p. 27.

HEMATITE.

Earthy red hematite, as shale, occurs in Sec. 2, T. 4 S., R. 4 E., at the Ladd Manganese Mine.

LIMESTONE.

A limestone quarry was opened up in 1900, about one mile south of Carnegie. The stone was burned and the lime used for building purposes at Tesla and Carnegie. The deposit consisted of veins of aragonite from three inches to three feet in width, and there was much waste in quarrying. It has been abandoned for many years.

Bibl: State Mining Bur. Bull. 38, p. 79.

MANGANESE.

The first manganese mining in California was done in 1867 at the Ladd Mine, located in Sec. 2, T. 4 S., R. 4 E., San Joaquin County. This mine was opened up by A. S. Ladd and worked by him until 1874, during which time about 5000 tons of ore were shipped to

England. In 1874 it was bought by Justinian Caire, of San Francisco, but shortly afterward shipments of California ore to England were stopped by the impossibility of competing with Spanish manganese, so that comparatively little ore was shipped for many years. In 1916 the mine was taken over by M. C. Seagrave, of the Western Rock Products Co., San Francisco. During the war it became the largest single producer of manganese ore in the state.

All of the manganese deposits in San Joaquin County are associated with an extensive area of Franciscan formations, extending south and southeast of Tesla, and covering parts of Alameda, San Joaquin, Stanislaus, and Santa Clara counties. This area, consisting mainly of sandstones and serpentine with lenses of chert, is approximately 12 miles wide at its northern edge along the south side of Corral Hollow Creek. Three townships south of there it is at least 18 miles wide.

Exploration and development work have revealed three main mineralized belts in this area: 1. An eastern belt, largely of chert and containing deposits of manganese, some of them yielding ore of very good grade. Most of the deposits in San Joaquin County are in this eastern belt. 2. A western belt, largely of serpentine bodies, but with chert and sandstone also present. Deposits of manganese have been noted in the chert and a few of them, lying mainly in Alameda and Santa Clara counties, have been worked. 3. Between these two above-noted belts, at least in the northern part of the area in Alameda County, there appears to be a third belt showing deposits of manganese of lower grade than those of the other belts.

The manganese orebodies, whether veins or lenses, though occurring in somewhat regular belts as noted above, have no regularity of strike or dip. The individual orebodies strike through all the intermediate angles from N.-S. to E.-W. They occur as interbedded lenses in jasper, varying in extent and thickness as well as character. In places the ore is deposited as the porous black dioxide, but often merely as stains along cracks in the jasper. No large mines have been developed in San Joaquin County except the Ladd Mine, but a number of other prospects have been more or less productive. Activities here gradually diminished since 1918, and ceased in the county in 1923.

Crocker Properties. This property includes about ten sections in San Joaquin County. M. I. Crocker, 1023 Insurance Exchange Building, San Francisco, owner. The principal deposit that has been noted is on Sec. 35, T. 4 S., R. 4 E. There has been no recent production.

Ladd Mine. Owned by Patrick Connolly, Tesla Road, Livermore; John Merchant, lessee, Livermore. The orebody at this mine strikes N. 10° to 30° W., dipping southwest from quite flat to nearly vertical. It has been exposed along the strike for 2000 feet, varying in width up to 30 feet, but averaging four or five feet. The ore in the main body is the hard, massive oxide, black or steel gray in color, and without crystalline structure, so that it is impossible to distinguish the particular oxide present, manganite, psilomelane, or pyrolusite. In the lowest tunnel rhodochrosite, the carbonate of manganese, occurs. It has been opened up by both tunnels and shafts. The ore is handled by truck to Livermore. The most recent production was made in 1923 by John Merchant, of Livermore, since which time it has been idle.

Winship Properties. This property, owned by the K. D. Winship Estate, 350 Post Street, San Francisco, includes about eight sections of land in San Joaquin County, on some of which manganese ore has been developed and shipments made by various lessees. The principal occurrences are in Secs. 3, 11, and 13, T. 4 S., R. 4 E., and Sec. 19, T. 4 S., R. 5 E. Sec. 11 adjoins the Ladd Mine on the south, and shipments have been made from both sections 11 and 13. There has been no recent production.

Bibl: State Mineralogist's Reports X, p. 564; XIII, p. 507; XIV, pp. 621–622; State Mining Bur. Bull. 76; U. S. Geol. Survey Bull. 427.

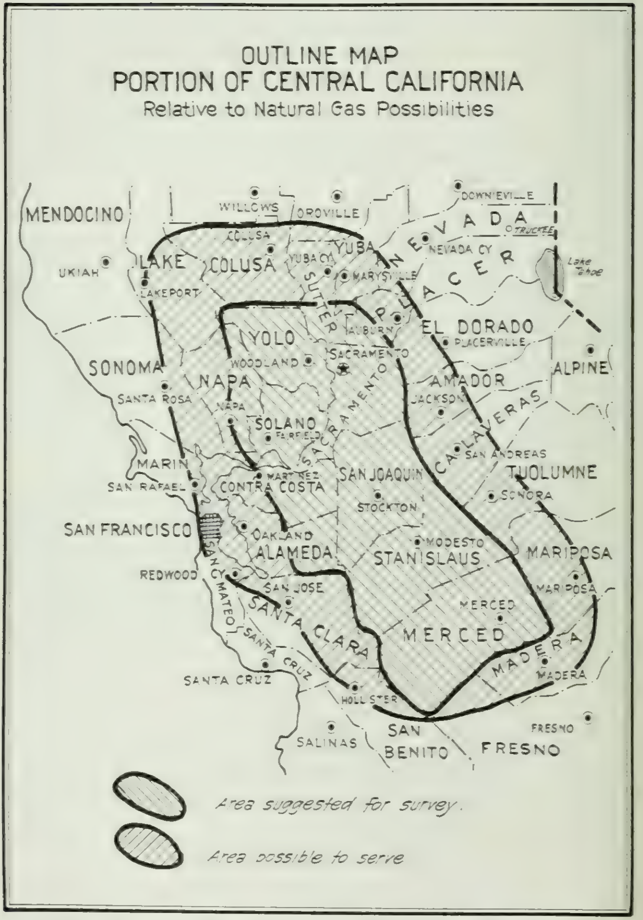
NATURAL GAS.

One of the peculiarly elusive and at the same time very valuable mineral resources of San Joaquin County is natural gas. All of the natural gas produced in the county at the present time comes from wells located within the city limits of Stockton. The present and potential value of this fuel to the city and the surrounding country has been recognized by the public officials of Stockton, and, in cooperation with them, the State Mining Bureau, in 1923, prepared a tentative outline for a survey to determine the natural gas possibilities of the Stockton area, and the maximum territory that could be economically served by it, if an ample supply were developed. These areas are shown on the accompanying outline map of the central valley counties, with Stockton as the hub.

In considering such an investigation, the following points were emphasized: (a) That the survey should be under the technical direction of the State Mining Bureau; (b) a preliminary investigation should be made to bring down to date all existing data relative to occurrence and production of natural gas within an approximately rectangular area, with Stockton as its center, 200 miles in length and of an average width of 75 miles; an area covering, therefore, approximately 15,000 square miles; (c) any locality, to be considered as coming within the survey, should be closer to Stockton than to the oil fields of Midway and Elk Hills; (d) transportation is one of the primary limiting factors in gas utilization. There is an adequate gas supply in the Elk Hills in Kern County for use in Fresno, Hanford, and Visalia, but the amount that would be used there does not justify the investment in transportation facilities. Assuming that a supply of gas could be developed near Stockton in quantity equal to the potentialities of Midway and Elk Hills, Fresno would be just as far from Stockton as from Midway, and therefore no more likely to be a user of Stockton gas. (e) It would be well to determine how much gas can be used by communities lying within a radius of 75 miles of Stockton.

The carrying out of the program is being held in abeyance until the necessary funds can be provided.

Western States Gas and Electric Co. Samuel Kahn, vice president and general manager; B. F. Wellington, secretary, Stockton, California. This company has an extensive gas manufacturing plant and electric plant, and is the owner of all the producing gas wells in the



Portion of Central California Relative to Natural Gas Possibilities

Stockton area. It has a total of 17 wells, of which 11 are producing gas at present. The natural gas is all piped to the central plant and mixed with manufactured gas before going to the consumer. The water flowing from the wells is not utilized except in the case of Jackson No. 1 and Jackson No. 2 wells. The flow from these two is made use of at the Municipal (Jackson) Baths. None of the water from the gas wells is suitable for irrigating, as it is brackish.

All of the company's producing gas wells are equipped with compressors, operated by electric power, which compress a portion of the gas collected in the receiver. This compressed gas is forced down the well in a pipe and as it escapes at the bottom it helps to decrease the pressure of the water column, and thus increases the natural flow of gas from the well.

Flow conditions of the various wells and physical data regarding them were published in Report XIV of the State Mineralogist (1913–1914), and for comparative purposes the present status of each well is given below:

Well (No. 1 of old Central Natural Gas Co.) This well was revived by use of a compressor. There is no water or gas flow except when the compressor is running. Present production, 14,000 cu. ft. per day.

Well No. 1. Now flowing. Production, 25,000 cu. ft. per day.

Well No. 2. Dead.

Well No. 3. Dead. Repair work was being done on this well when it went dead. Within 24 hours well No. 1, formerly dead, began flowing.

Well No. 4. Dead.

Well No. 5. Producing 27,000 to 28,000 cu. ft. per day.

Well No. 6. Producing 16,000 cu. ft. per day.

Well No. 7. Producing 40,000 cut. ft. per day.

Well No. 8. Producing 60,000 cu. ft. per day.

Well No. 9. Producing 120,000 cu. ft. per day. This is the most productive and best well owned by the company.

Well No. 10. Dead.

Well No. 11. This is a new well located on Lot 4, Block 42, Gardendale Tract, near the end of Charles Street. It was drilled in 1916 to a depth of 3100 feet, 10-inch casing to 3040 feet, and 8¼-inch casing for the balance of the distance. The water flow is approximately 1000 gal. per minute. Producing 50,000 cu. ft. of gas per day.

Citizen No. 1. Dead.

Citizen No. 2. Producing 39,000 cu. ft. per day.

Jackson No. 1. Producing 9000 cu. ft. per day.

Jackson No. 2. There is a water flow but practically no gas. The water formerly had a temperature of 84° F., but it is now cooler.

Glass Works No. 1. Producing 25,000 cu. ft. per day.

Glass Works No. 2. Producing 15,000 cu. ft. per day.

Bibl: State Mineralogist's Reports X, pp. 548–564; XIV, pp. 184–195.

PETROLEUM.

The areal geology of San Joaquin County is composed almost entirely of Cretaceous, Tertiary and Quaternary formations, which do not contain any indication of the presence of petroleum. Though yet unproved, there is no positive evidence that petroleum does not exist in buried structures beneath the valley floor, and only the drilling of test wells will definitely settle the question. Preliminary work along this line has been undertaken, and these activities are reported in the current issues of 'Summary of Operations, California Oil Fields,' to which the reader is referred. The oil possibilities from a geological standpoint are discussed in the publications given in the bibliography.

Bibl: State Mining Bureau Bull. 89; U. S. Geological Survey Bull. No. 603.

STONE INDUSTRY.

Crushed Rock, Gravel and Sand.

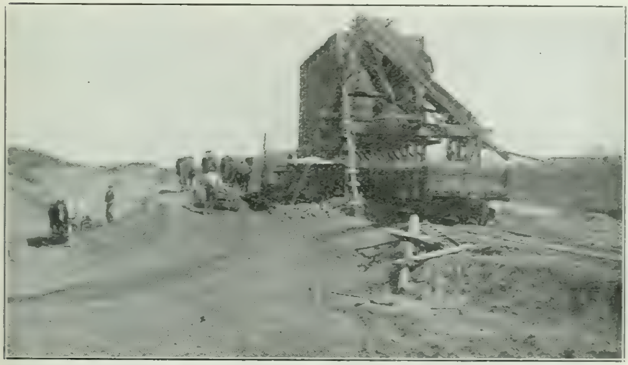
Arington and Putman Pit. Owned by Arington and Putman Sand and Gravel Co., P. O. Box 271, Escalon, California. The property, containing 24 acres, is located about one mile north of Riverbank in Sec. 24, T. 2 S., R. 9 E., on a spur track of the Santa Fe Railroad. Operations began in September, 1924. The deposit contains about 25 per cent gravel and 75 per cent sand. The sand and gravel strata have a total depth of about 25 feet, with clay underneath. At present the material is excavated by a steam hoist, using a Le Claire drag-line scraper, but it is the intention of the company to put in a steam-shovel. The material is elevated, run through a revolving washer and sand screen and then a gravel screen, giving three separate products, sand, pea gravel and a coarse gravel, or a concrete mixture of various sizes. Electric power is used, about 50 horsepower being required, except for the steam-hoist. The latter uses crude oil for fuel. Oversize gravel is crushed in a jaw crusher to 1$\frac{1}{16}$ inch, and mixed with the coarse gravel product. The capacity of the plant is 300 tons per day, and three men are employed.

Plant of Arington and Putman Sand and Gravel Co., San Joaquin County.

Bellota Gravel Pit. A crushed rock, gravel and sand washing and screening plant is located at Bellota, the terminal of the Stockton Terminal and Eastern Railroad, about 17 miles northeast of Stockton. The deposit is on the Mormon Channel of Stanislaus River. Gould and Johns, 123 South California Street, Stockton, were the former operators, but, due to litigation, the plant has not been operated during 1925. Electric power was used and the plant could probably produce 250 to

350 tons per day. It is understood that D. G. Johns, 434 E. Maple Street, Stockton, is now the owner.

Miller Gravel Pit (formerly Myers Pit). S. D. Miller, P. O. Box 314, Manteca, California, has a pit from which he is producing sand and gravel, in the S½ Sec. 17, T. 2 S., R. 8 E. The pit is located about three miles south of Escalon near the point where the Tidewater Southern Railway crosses the Stanislaus River. It was originally opened up by the Railroad Company as a source of ballast. Later it was leased and operated by the South San Joaquin Irrigation District. The present owner has been operating it the past two years. The washing plant is on a spur of the Tidewater Railroad, the site being leased. Area of deposit, ten acres. It consists of bench gravel and sand, adjacent to the present Stanislaus river channel. The material is mostly small gravel and sand, with very few boulders as large as a man's fist. It is brought to the plant by teams and Fresno scrapers, elevated and run over a screen, the gravel and fine sand being washed separately and then both run together to railroad cars for shipment. Two gas engines are used, one to run the elevator and the other to pump water for washing. There are no crushing or storage facilities in the present plant, but bunkers for a new plant have been erected. The capacity is about 200 tons of bank-run material per day, using two teams. Three men are employed. The material carries a cent or two a yard in gold.



Miller Gravel Pit, San Joaquin County, California.

Riverbank Sand Co.'s Property. Owned by the Riverbank Sand Company, Escalon, California, or 704 Market Street, San Francisco; Wm. H. Ford, president; B. R. Kimberling, plant superintendent. This property known as Santa Fe Gravel Pit contains nine acres, located in Sec. 23, T. 2 S., R. 9 E. Riverbank, the nearest town and railroad station, is 1¼ miles south of the pit. The present company has been operating about eight years. The deposit is mostly fine gravel and sand, containing only about two per cent of coarse gravel. The material is excavated by a gasoline drag-line scraper with a half-yard bucket mounted on caterpillar tracks, and loaded into hopper bottom cars. These are hauled by a gasoline locomotive to the washing plant hopper and dumped. The material is elevated by a bucket elevator, and passed through a revolving screen with 1-inch holes and jacket, giving a concrete sand from 1-inch down and a plaster sand of 8-mesh size. The plant is on a spur track of the Santa Fe Railroad, and the cars are loaded direct. Electric power is used for operating and pumping the wash water, a total of 40 horsepower being used. The plant has a capacity of about 300 tons per day, and three men are employed. Large quantities of the sand have been used as a gunite sand in lining irrigation ditches in the South San Joaquin Irrigation District.

River Rock Gravel Co. Wm. H. Ford. president; home office, 704 Market Street, San Francisco: Earl Williams, general manager at plant, local address, Tracy, California. This plant, which is of excellent design and operated entirely by electric power, is located seven miles south of Tracy on a branch line of the Western Pacific Railroad. It is situated on Tesla Creek at the mouth of Corral Hollow Canyon near the point where the creek breaks into the basin of the San Joaquin. The surface here is fairly level, the elevation at the plant being approximately 135′. There is no timber. The area of the company's holdings is 90 acres. Operation of the plant began in 1916. The material utilized is sand, gravel, and boulder wash from the bed of Tesla Creek. This wash extends up the creek for 15 miles above the plant. The creek is subject to heavy floods during the rainy season, and much material is brought down during these floods, partly replenishing the supply. The material is taken from the creek bed by an electric drag-line excavator and loaded onto a grizzley car. This is a standard gondola car with a superstructure of inverted 56-lb. rails set at an angle of about 45° and spaced so as to eliminate all boulders too large for the primary crusher, a No. 5-K gyratory. This car is

Pit of Riverbank Sand Co., near Escalon, San Joaquin Co., California.

hauled by a 12-ton electric locomotive to the dumping pit at the plant. From the pit the material is carried by a belt conveyor to the highest point of the washing plant. The material delivered by the conveyor is classified into large size (3″ grizzley) for the gyratory, medium size (1⅝″) for the disc crusher, and the balance for the conical screens. The discharge from the gyratory and disc crushers is run by separate belt conveyors to independent conical screens. The main conveyor is arranged so that material from any bin in the washing plant can be fed onto it for mixing purposes. This mixed material or a regular sized product can be run to bins, cars or storage. The finished materials supplied are No. 1 gravel, 1″ to 1½″; No. 2, 2½″ to 1″; No. 3, ¼″ to ½″; No. 4, sand to ¼″; No. 5, crushed rock, ¼″ to ⅝″; No. 6, crushed rock, ⅝″ to 1¼″; No. 7, crushed rock, 1¼″ to 1¾″; No. 8, cementing road gravel. Water sprays are placed in each conical screen and assist in moving the material, as well as washing it. The electric dragline excavator has a 1½-yard bucket. The electric locomotive and locomotive crane are operated by the third rail system, eliminating all overhead structures near the tracks and permitting free use of the booms at any point. The water supply is obtained from springs in the canyon and is pumped 3650 feet in a 10″ wooden pipe. The water is returned to a settling pond, the overflow of which goes to a second reservoir. Fine material, which settles, is removed as occasion demands and sold for filling. A small auxiliary plant supplies the cementing road gravel, which is obtained by digging below the gravel stratum and including a portion of the underlying clay. Power is furnished by the Pacific Gas and Electric Company. The plant is operated one 9-hour shift daily, and 16 men are employed. The present capacity is 1000 tons daily, but the plant is designed for 2000 tons and this can be obtained by adding screens to the other half.

Plant of River Rock Gravel Co., near Tracy, San Joaquin Co., California.
Photo by courtesy of River Rock Gravel Co.

Stockton Mineral Products Co. A. B. Foote, president; E. W. True, manager; home office at the plant, 402 West La Fayette Street, Stockton, California. There is a Southern Pacific spur track and Western Pacific connection to the plant. The products are white and colored roofing and stucco 'dash' rock. The crude materials consist of quartz and mariposite from near Jamestown, dolomite from near Sonora, light and dark red rock from Ione, and green rock from Yosemite Valley, supplied under contract by local producers. A new unit to the plant is under construction. In the original unit the material was fed to a 10″ x 18″ Dodge crusher, elevated to a revolving screen which delivers three sizes of roofing grit; the oversize passing through 14″ x 24″ rolls in closed circuit. In the new unit, material from the bins in the first unit is elevated to a 2-unit Hummer vibrating screen at the top of plant, which delivers various fine products. The oversize goes to a small hammer mill in closed circuit. Electric power, furnished by the Pacific Gas and Electric Company, is used, about 50 horsepower being required. When completed, the plant will have a capacity of 400 tons of finished materials per month.

Western Pacific Pit. W. A. Bechtel, contractor, 625 Market Street, San Francisco, is producing 'pit run' gravel and sand for the Western Pacific Railroad Company from a deposit along their right of way about one mile southwest of Carbona. The material is wash brought down by Tesla Creek. A Bucyrus steam shovel, with $1\frac{3}{4}$-yard bucket, is used, and the gravel is loaded direct to railroad cars. The railroad company is utilizing it for track ballast and filling in the vicinity of Stockton. Operations began March 1, 1925.

STANISLAUS COUNTY.

By C. McK. Laizure, Mining Engineer.

Introduction.

Stanislaus County was created on April 5, 1854, from territory previously a part of Tuolumne County. In 1860 a triangular piece north of the Stanislaus River, and including Knights Ferry, was taken from San Joaquin County and added to Stanislaus. With this addition, the county boundaries became practically the same as they are today. Knights Ferry was made the County Seat about this time, but later the county offices were transferred to Modesto, the present County Seat.

Geography and Geology.

Stanislaus County is situated in the San Joaquin Valley between San Joaquin County on the northwest and Merced on the southeast. It is bounded on the northeast by Calaveras and Tuolumne counties, and by Santa Clara on the southwest side. Stanislaus County contains 1486 square miles, and its population is 43,557 (1920 census). The greater part of its acreage is arable, and about one-half is capable of irrigation. The various branches of agriculture and stock-raising are the principal pursuits followed.

The county extends across the San Joaquin Valley in a northeasterly direction from the summit of the Mt. Diablo Range on the west to the foothills of the Sierra Nevadas on the east. The central portion is composed of unconsolidated sands, gravels and clays. Bordering this formation on the northeast, with the line of contact a little above Oakdale and Waterford, is a belt of older Tertiary clays, shales and sandstones. This Tertiary belt extends to and comes in contact with the slates, limestones and other rocks of the Jurassic along a line which closely follows the northeastern boundary of the county. On the southwest, the low foothills of the Coast Range are made up of Cretaceous sandstones and shales. The extreme western portion is rugged and composed of Franciscan formations, typical of the Coast Range; consisting of altered slates, cherts, massive sandstone, schists and serpentine. Deposits of magnesite, manganese and quicksilver occur in this area.

Mineral Resources.

Gold has usually been the chief mineral product of Stanislaus County, but gold was exceeded in value in 1918–1919 by manganese, and in 1921–1923 by miscellaneous stone. Gold, platinum and silver are obtained mainly by dredging. Quicksilver and manganese are other metals found here also. Among its non-metallic resources are clay and clay products, ocher, magnesite, silica, and miscellaneous stone, including crushed rock, gravel and sand. Other minerals occur, but the deposits in most cases have not been sufficiently developed to determine their commercial value. The value of the counties' mineral products has exceeded a half million dollars in some years. In 1923 the output amounted to $445,515, which was slightly less than in 1922. This gave the county thirty-third place for that year, with 25 counties showing a smaller output.

In the following report an endeavor has been made to give a complete summary of the mineral resources of the county so far as they are known at this time, but only active properties are described in detail.

The total recorded output from 1880 to 1923 is shown in the following tabulation:

Year	Gold, value	Silver, value	Brick		Magnesite		Manganese	
			M.	Value	Tons	Value	Tons	Value
1880	$73,271							
1881	63,000	$31,000						
1882	80,000	15,000						
1883	40,000	5,000						
1884	40,000	5,000						
1885	18,660							
1886	47,175							
1887	53,297							
1888	75,000							
1889	20,410							
1890	5,335							
1891	3,000							
1892	14,191							
1893	150							
1894	26,369							
1895	26,482							
1896	16,635							
1897	37,392							
1898	19,400							
1899	10,000							
1900	[1]21,212							
1901	[1]15,700				100	$600		
1902								
1903	[1]52,869	256						
1904	[1]50,000	265						
1905	[1]50,000	240						
1906	(2)	(2)						
1907	3,364	28						
1908	(2)	(2)	750	$7,000				
1909	(2)	(2)	5,000	50,000				
1910	[1]214,187	[1]504	1,500	8,000				
1911	[4]307,538	[4]1,131	850	5,950				
1912	[1]226,163	[1]1,974	250	2,000				
1913	[5]253,166	[5]671	300	2,400				
1914	(2)	(2)	250	2,500				
1915	(3)	(3)						
1916	(3)	(3)	(3)				160	$2,400
1917	(3)	(3)			3,196	44,350	775	26,925
1918	14,196	592			2,024	18,038	5,753	222,422
1919	(3)	(3)			2,031	20,831	8,921	374,584
1920	142,467	775			4,064	39,435	893	12,973
1921	18,439	136			3,378	33,158	(3)	
1922	(3)	(3)			2,400	35,475	(3)	(3)
1923	174,814	833						
Totals	[3]$2,313,882	[3]$63,505	[3]8,900	$77,850	17,093	$191,287	[3]16,502	$639,304

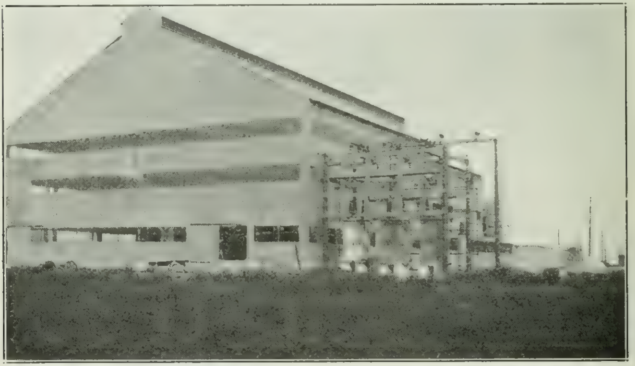
[1] Includes Merced County.
[2] See Merced County.
[3] See under 'Unapportioned.'
[4] Includes Merced County production; also dredge yield of Shasta and Trinity Counties.
[5] Includes dredge production of Merced and Siskiyou Counties.

COUNTY, 1880-1923.

Mineral paint		Miscellaneous stone, value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
105	$2,310	----------	----------	----------	
375	2,800	----------	20 flasks	$800	Quicksilver.
17	1,800	----------	----------	----------	
152	1,825	----------	----------	----------	
283	2,898	----------	----------	----------	
204	1,769	----------	----------	----------	
129	193	----------	----------	----------	
200	375	----------	79,330 lbs.	12,494	Copper.
200	350	----------	162,400 lbs.	18,676	Copper.
1,370	2,400	----------	116,600 lbs.	15,080	Copper.
200	1,600	----------	7,300 lbs. ----------	931 20	Copper. Platinum.
375	2,125	----------	----------	----------	
250	1,720	----------	----------	----------	
250	1,720	----------	----------	----------	
285	2,000	$74,000	----------	----------	
285	2,225	225	----------	82,317	Unapportioned, 1900-1909.
40	270	----------	----------	----------	
96	600	----------	----------	----------	
100	600	63,572	----------	----------	
255	1,530	14,482	----------	----------	
52	286	3,096	----------	----------	
(3)	----------	2,250	----------	189,521	Gold, mineral paint, silver, platinum, quicksilver.
507	2,200	17,784	----------	230,638	Chromite, brick, gold, platinum, quicksilver, silver.
(3)	----------	6,240	1,438 tons ----------	29,240 183,167	Chromite. Gold, mineral paint, platinum, silver.
498	3,088	38,764	1,352 tons ----------	56,505 308	Chromite. Other minerals.
(3)	----------	28,922	----------	[1]165,989	Gold, mineral paint, platinum, silver.
669	7,062	181,262	----------	1,043	Platinum and quicksilver.
(3)	----------	180,697	----------	3,777	Manganese, mineral paint, platinum, quicksilver.
(3)	(3)	299,962	----------	116,730	Gold, manganese ore, mineral paint, platinum, and silver.
1,023	10,745	231,965	----------	27,158	Magnesite, manganese ore, platinum.
[3]7,920	[3]54,491	$1,143,221	----------	$1,134,394	

BARIUM PRODUCTS.

D-V-O Products, Inc. C. E. Gilman, president; Norman de Veaux, vice president, 1101 Oakland Bank Building, Oakland; Albert Breed, secretary; home office, 102 Olive Avenue, Modesto, California; Alexander Bonnington, plant manager, Modesto. D-V-O Products, Inc., is a close corporation, organized for the purpose of manufacturing a number of chemical and allied products. The main materials to be utilized include a number of crude minerals. Insecticides, hydrogen peroxide, pigments, and lime sprays will be made. Raw materials will consist mainly of limestone; barytes, either barite or witherite, and beet molasses. The plant, which is of concrete and steel frame construction, is expected to start about July 1. Much equipment in the form of machinery and apparatus is already installed, and about 1500 tons of barytes are on hand. Steam boilers of 250 horsepower are installed to furnish steam for processing, and the plant is equipped for 1600 electrical horsepower for operation, although this amount will not be required at all times. When the period of normal operation is reached, the daily consumption of raw materials is expected to be from 10 to 20 tons of off-color barite, or up to 80 tons if white barytes can be obtained; 20 tons of limestone and 60 tons of molasses, and it is estimated that 100 men will be employed.



Plant of D-V-O Products, Inc., Modesto, California. (Under construction.)

CLAY.

The true nature, value and extent of the clays in Stanislaus County are practically unknown, as they have been utilized only in a very limited way. High-grade pottery clay probably occurs, if at all, in limited amount, but deposits of low-grade clay, suitable for the manufacture of common brick, have been worked at various times in the past near Modesto, Grayson, Newman, and Patterson.

At the present time there is no brickyard in operation in the county, and none of the clay is being used for any purpose.

The Craycroft brickyard at Modesto produced regularly between 1908 and 1916, but it is now dismantled, and the land has been sold for town lots.

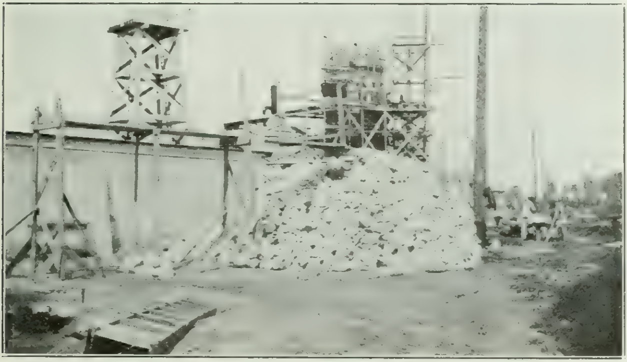
Some bricks were manufactured in 1918 and 1919 by Martin Kelch from a clay deposit having a maximum thickness of 20 feet, situated on the Waterford road, about one mile east of Modesto. Operations were discontinued here in 1919.

There is a deposit of clay in Secs. 20 and 21, T. 5 S., R. 7 E., about 3½ miles northeast of Patterson, which is said to analyze about 60% silica, 24% alumina, 3% iron, and a little magnesia. It is not being utilized.

Bibl: State Mineralogist's Report XVII, p. 253; State Mining Bur. Prel. Report No. 7, p. 99.

COAL.

Small veins of coal have been discovered from time to time in the southwest portion of the county, notably on Ensalada Creek in Sec. 12, T. 6 S., R. 7 E., and in Ingram Canyon, near Sec. 12, T. 5 S., R. 6 E. A vein of coal, 2 feet in thickness, is said to have been passed through in boring a well on the David Hoges Ranch, 13 miles northwest of Newman. None of these deposits has been thoroughly investigated, and they remain undeveloped.



Plant of D-V-O Products, Inc. (under construction), showing stock of raw material on hand.

Bibl: State Mineralogist's Reports X, p. 581; XVII, p. 253. U. S. Geol. Survey Mineral Resources, 1892, p. 310.

CHROMITE.

Stanislaus County became a producer of chrome ore early in 1916, its existence up to a short time previous having been unsuspected. A total of several thousand tons was subsequently shipped out of the county, principally to steel plants. The deposits are situated on the east slope of the Coast Range Mountains, in Del Puerto Canyon and its branches.

The occurrences of chrome ore in this region may be grouped under two heads: (1) Lenses of hard massive black ore, containing little or no serpentine, and having a well-defined contact with the surrounding serpentine, and (2) deposits of gray ore mixed with the serpentine and grading into it. The serpentine belt is fairly extensive here, striking northwestward, with the trend of the mountains, and being evidently a continuation of that in which the Cedar Mountain deposits of Alameda County occur.

In this same area are located the Red Mountain magnesite deposits, as well as several old quicksilver mines; namely, the Adobe Canyon, Deer Park and Phoenix mines.

Activities reached a maximum during the period of high prices due to the world war. The Patterson and Western Railroad (narrow guage) had been built from Patterson up Del Puerto Canyon to the foot of Red Mountain, 23 miles, to Camp Jones, principally to facilitate shipments of manganese from Santa Clara County properties, but giving access to the chromite deposits, as well. A half dozen properties were opened up in the vicinity of Camp Jones, including that of the Chrome Concentrating Co., which erected a concentrating mill; the Lucky Girl Prospect; the McGuire, Holbrook and Springer Property; the Mineral Product Co's Property, and the Plattner Deposit. All work ceased, however, in 1918 with the ending of hostilities and consequent collapse of the chrome market. The railroad has since been torn up, and all mine surface equipment dismantled. While these deposits are valuable as an emergency reserve source of chrome ore, under present market conditions they can not be profitably worked.

Bibl: State Mining Bur. Bull. 76, pp. 203–205.

DIATOMACEOUS EARTH.

Diatomaceous earth of good quality occurs in the hills west of Newman, and Crows Landing. The white outcrops can be traced for long distances in this county and further south into Merced County.

In places these diatomaceous shale beds reach a thickness of several hundred feet. Notable deposits are found in the low hills between Orestimba and Little Salada Creeks. J. G. Walker et al located a claim here about 1920. There has been practically no development on any of the deposits, but they have considerable potential value.

Bibl: U. S. Geological Survey Bull. 603, p. 211.

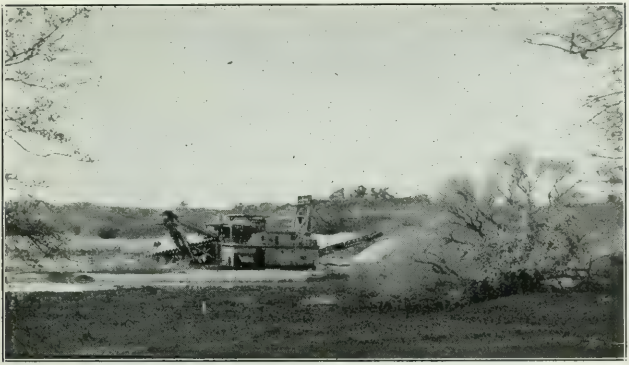
GOLD, SILVER AND PLATINUM.

Two gold quartz mines are of record in this county: The Alto, near Knights Ferry, long since abandoned, and the Don Pedro, near Cooperstown, now included in Turlock Irrigation District reservoir site.

The production of the precious metals, with the exception of occasional small amounts obtained by 'crevicing' on the rivers, now comes entirely from gold dredging operations on the Tuolumne River near La Grange.

The dredge of the Yankee Hill Gold Mining Co., which began digging in the Stanislaus River, 1½ miles below Knights Ferry in November, 1920, was soon after torn from its moorings and wrecked on a sand bar above Orange Blossom bridge east of Oakdale. It was later sold and dismantled.

La Grange Gold Dredging Co. John G. Barker, president, C. E. Taber, secretary, 321 Union Oil Building, Los Angeles. Home office, La Grange; H. G. Kumle, superintendent. This company owns a large acreage in T. 3 S., R. 13 E., and T. 4 S., R. 14 E., about 400 acres of which are classed as dredging land. Of this area, about 65 per cent has been worked out, and 35 per cent remains to be dredged. The dredge is at present digging in the Tuolumne River near the outskirts of La Grange. Cooperstown, on the Sierra-San Francisco Railroad, is the nearest railroad station. River gravel bars, exclusively, are worked. The company operates one dredge. It has a wood hull, 42′-7″ x 110′ x 9½′ deep, and was completed and put in commission three years ago, replacing an older dredge. It is equipped with 9½ cu. ft. buckets, close connected, and can dig 40 feet under water. The average depth of the ground being worked is 32 feet. There is very little clearing of brush or timber required, but a good many large boulders are encountered. Electric power is used, furnished by the Pacific Gas and Electric Company. The connected load is 515 horsepower. The gold recovered is fine, but of good grade. Platinum and iridium comprise approximately two per cent of the total value recovered. The recovery of platinum metals has been increased by the use of cocoa matting in the sluices. During the year 1924 a total of 1,698,791 cubic yards of gravel was handled, with a recovery of 11.64¢ per yard, at a cost of 6.24¢ per yard, not including depreciation or depletion.



Gold dredge of La Grange Gold Dredging Co., on Tuolumne River, Stanislaus County.

The dredger crew consists of ten men, and an equal number are employed outside and in the shops. In addition, two drilling crews are kept busy prospecting the ground, requiring about seven men, making a total of 27 or 28 men.

Bibl: State Mineralogist's Reports X, p. 681; XII, p. 294; XIV, p. 629; XVII, p. 254; XVIII, p. 103. State Mining Bur. Bull. 57, pp. 209–211; Bull. 85, pp. 33, 100–101.

GYPSUM.

Gypsum in the form of selenite has been found in the vicinity of Modesto, but no massive deposits of commercial value are known.

Bibl: State Mining Bur. Bull. 91, p. 272.

HEMATITE.

A foliated variety of hematite, of mineralogical interest only, occurs near La Grange.

Bibl: State Mining Bur. Bull. 91, p. 103.

MAGNESITE.

That magnesite deposits occurred on the Stanislaus County side of the Coast Range at several points from Red Mountain south was known for many years, but little attempt was made to exploit them prior to 1916. Active development began about that time due to the building of the Patterson and Western Railroad from Patterson to the foot of Red Mountain, and the insistent demand for magnesite created by war conditions. Production was fairly steady from 1917 to 1922, averaging from 2500 to 3000 tons annually. The output decreased in 1923 and ceased entirely in 1924.

The Bald Eagle claim, in Sec. 32, T. 8 S., R. 7 E., and the Quinto claim, in the south half of the same section, together with other claims, were mined under lease during 1917 and part of 1918 by the Gustine Magnesite Co. These claims were all on Quinto Creek, about 16½ miles west of Ingomar, near the Merced County line. The Howard Cattle Company, Sharon Building, San Francisco, own Sec. 5, T 9 S., R. 7 E., on which a large body of magnesite was opened up and mined by lessees. In places on this property the ore was stoped for a width of 12 feet, and several thousand tons were shipped from here. The Plastic Magnesite Company leased a deposit located in Sec. 32, T. 8 S., R. 7 E., and were producing about 30 tons daily in 1920. Magnesite also occurs in Sec. 28, T. 7 S., R. 6 E., but it has been only slightly prospected.

In the Red Mountain area, G. L. Fenster et al., of Patterson, own five claims in Sec. 22, T. 6 S., R. 5 E., on which there is a ledge about nine feet in width, only slightly developed. Adjoining, in Sec. 20, T. 6 S., R. 5 E., is the Red Mountain Magnesite mine (California Magnesite Co.). This property has been the most important producer of magnesite in Stanislaus County.

California Magnesite Co. G. A. Scott, president; M. W. Kirk, secretary; home office, Fifth and Parker Streets (Blanding Iron Works), Berkeley; J. Frame, superintendent, Patterson, California. This mine is situated on the Stanislaus County side of Red Mountain in Sec. 20,

T. 6 S., R. 5 E., at an elevation of 2500′. There is no timber but considerable brush. A large spring supplies all the water needed.

The property consists of four claims and a mill site, a total of about 85 acres. The deposit was discovered in 1915 by James and Plunket. The original company was known as the Red Mountain Magnesite Co. Later it was called the W-K Co. In January, 1922, it was reorganized as the California Magnesite Co.

View near head of Del Puerto Canyon, Stanislaus County, showing Red Mountain in background and California Magnesite Co.'s mine (white spot in middle distance).

The deposit consists of parallel lenses of high-grade magnesite in serpentine country rock, of which Red Mountain is composed. Operations have been by glory hole and stoping from the main tunnel level.

Two lenses, 18 feet and 25 feet wide respectively, at the tunnel level have been stoped from there to the surface. The main tunnel, which is 1300 feet in total length, has apparently cut the top of two other lenses. The orebodies strike N. 20° W. and dip about 85° into the mountain. The total production since the mine was opened up has been approximately 50,000 tons. This was calcined in part at the mine and also at the calcining plant of the Mineral Products Co. in Patterson, which was taken under lease. The calcining equipment at the mine consists of a shaft furnace of 15-tons daily capacity and a small rotary furnace used mainly for burning fines. Crude oil is used for fuel. Mine equipment consists of two 70-h.p. boilers, a 7-drill Ingersoll-Rand compressor, steam hoist and pumps for handling the water supply, and fuel oil. There is also a 25-h.p. gas engine and 2-drill Sullivan Compressor, cars, track, etc. The camp buildings will accommodate about 30 men.

Practically all ore above the present adit was taken out and the mine was shut down in September, 1923, pending additional development. Another adit about 250′ below the upper one had just been started to cut the orebodies exposed in the upper adit. This adit will have to be driven about 900 feet to reach the ore.

Negotiations are now under way looking to the immediate completion of the new adit and resumption of full operations. It is probable that this move will include taking over the calcining plant of the Mineral Products Co. and possibly the moving of the 90-foot rotary kiln, with which it is equipped, to the mine as it has proved more economical to burn the magnesite at the mine than to transport the crude material. The road bed of the former Patterson and Western R. R., which ran from Patterson to the foot of the Red Mountain, makes an execllent graded road to within a short distance of the mine, so that the property is not difficult of access.

Bibl: State Mineralogist's Report XVII, p. 254. State Mining Bur. Bull. 38, p. 33; Bull. 79.

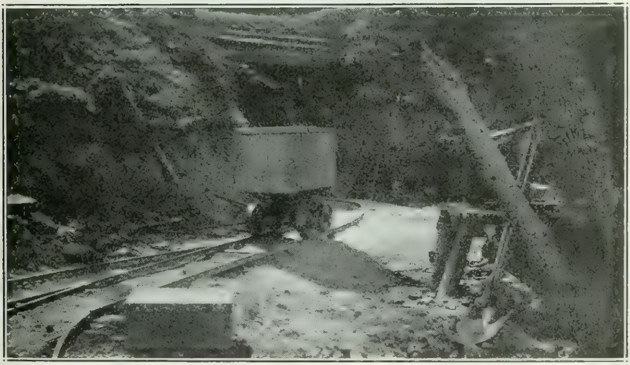
Mineral Products Co. James Spaulding, Trustee, care W. P. Fuller and Co., 301 Mission Street, San Francisco. This company was organized in 1915, and acquired extensive manganese and chrome deposits in Santa Clara and Stanislaus counties. They constructed the Stanislaus and Western Railroad from Patterson to the foot of Red Mountain, and a 2-foot gauge gasoline tramway, 5 miles in length, from the railroad to the mines. A plant for the manufacture of manganese dioxide was erected in Patterson but later developments in the manganese and magnesite situation led them to abandon the first idea, and the plant was converted into a calcining plant and factory for the manufacture of magnesia products. A 90-foot rotary kiln was installed and much other machinery. It did not prove a financial success, and the plant was shut down, and the company passed into the hands of a receiver. Negotiations are now under way looking to the utilization of the calcining equipment by the California Magnesite Co.

MANGANESE.

The manganese deposits occur in the southwestern part of the county, being found in a southeasterly extension of the area of Franciscan rocks referred to in more detail in the report on San Joaquin County.[1]

The California Manganese Co. was one of the first operators to start development in Stanislaus County. This company controlled five unpatented claims and 2160 acres of patented lands in Secs. 9, 11, 15, 21, 22, 27, 28, 33, and 34, T. 6 S., R. 5 E., and began development in 1914. In 1915 the Mineral Products Co., of San Francisco, took over these holdings, part being in Santa Clara County. Production from Stanislaus County began in 1916. Activities increased with the war demand for manganese, and lessees were soon developing deposits,

Portion of plant of Mineral Products Co., Stanislaus County, California.



Entrance to upper adit, Liberty Manganese Mine, Stanislaus County, California.

---

[1] See page 191, *ante*.

mainly on lands of the Winship Estate, the Crocker Properties and on the Grummit Ranch. On the Winship Lands mines or prospects were opened up on Secs. 1, 3 and 13, T. 5 S., R. 5 E., and on Secs. 17 and 19, T. 5 S., R. 6 E. Shipments were made by the Manganese Products Co., lessee, from a deposit on Sec. 6 T. 5 S., R. 6 E., a portion of the Grummit Ranch. Another deposit has been noted on Sec. 8, T. 6 S., R. 6 E., and slightly prospected.

Loading manganese ore on truck, Liberty Manganese Mine, Stanislaus County, California.

The most important of the above was the *Buckeye Mine* [1] of the Winship Estate, in Sec. 3, T. 5 S., R. 5 E., on a branch of Hospital Creek southwest from Vernalis. This mine was one of the largest three producers of the state during 1918-1919, and yielded a total of approximately 14,000 tons during that period of activity. Ore was first mined here in an open-cut stope which revealed an orebody 20′ wide and over 75′ long carrying 48% Mn; and, later, by means of a shaft and underground stopes. The shaft is over 300′ in depth. The ore in the lower workings is mainly carbonate (rhodochrosite). The Suffern Company of New York, lessees in 1918-1919, put in an aerial tramway which transported the ore from the mine to loading bunkers for auto trucks about a half mile down the canyon.

---

[1] Bradley, W. W., Manganese production in 1919: Cal. State Min. Bur., Bull. 88, pp. 47-48, 1920; also Bull. 76, pp. 85-87, 1918.

Manganese mining almost ceased when the war emergency ended, and importation of foreign manganese ores was resumed. At the time of visit (March, 1925) only one mine was active in the county.

Liberty Manganese Mine. This property consists of five claims, located in Sec. 36, T. 4 S., R. 5 E., owned by the Ferro-Manganese Co., 703 Hobart Building, San Francisco; F. E. Hartzell, president; Robt. C. Oliphant, vice president. The company was organized in 1923, but did not get into production until 1924. The deposit is opened up by two tunnels. The upper or main adit is approximately 250 feet long. It is run as a crosscut for about 50 feet and then on the vein, which has been stoped for a width of four to six feet from this level to the surface and understoped in places to a depth of 35 feet. Another tunnel has been started 105 feet lower as a crosscut. The latter is in approximately 240 feet, but it will have to be run considerably farther to get under the orebody, now being worked in the upper tunnel. The property is equipped with a 40-h.p. Fairbanks-Morse gas engine, 10″ x 10″ Sullivan compressor, track, cars, and camp buildings. The number of men employed varies from three or four to eight or nine, depending on the size of the orebody and other conditions. The ore produced averages about 45% manganese. It is hauled 14 miles by truck to Westley for shipment.

Bibl: State Mining Bur. Bull. 76, pp. 83–87; State Mineralogist's Report XIV, p. 630; U. S. Geol. Survey Bull. 467.

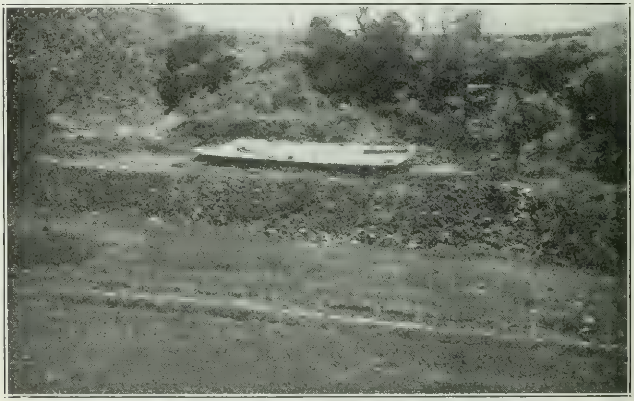
MINERAL PAINT.

Mineral paint material, mainly in the form of yellow ochre, has been mined on a small scale in the vicinity of Knights Ferry for many years. Outcroppings occur in many places on both sides of the river, but only three properties are at present developed to a point where production can be made.

California Ochre Mining Co. Address, 665 Third Street, San Francisco; C. H. Kaul, manager. This property, consisting of 34 acres, is a part of the old Voyle holdings. The above company has owned it for the past 30 years, and has produced a large amount of ochre during that time, though operations have been intermittent, depending on demand. The deposit is located in Sec. 17, T. 1 S., R. 12 E., and consists of a stratum of soft yellow ochre from four to six feet in thickness, in the form of a very flat anticline. It has been opened up by a number of drifts. Mining is usually done by local parties, under contract.

Weidman Ranch Deposit. Prowse and Williams, owners, Knights Ferry, California. This deposit is on the south side of the river, directly opposite Knights Ferry. The ochre stratum on this property is from 4 to 6 feet in thickness. About two acres have been worked out. It has been idle for the past 18 months, during which time high water filled the drifts, and caved in much of the workings so that it will be necessary to run a new drift when production is resumed.

Voyle Mine. Owner, V. J. Winkler, Knights Ferry, California. This property is in Sec. 29, T. 1 S., R. 12 E., M. D. M., on the north side of the Stanislaus River at Knights Ferry, thirteen miles by paved highway east of Oakdale, the nearest railroad point. There are 60 acres in one tract on which most of the mining has been done and another tract of 18 acres, undeveloped. The present owner has had the property for 7 years. The deposit consists of a stratum of yellow ochre, varying from 5 to 8 feet in thickness, lying practically horizontal, with clay below. It is opened up by drifts, with pillars left to support the roof. The material varies in hardness, it being quite soft in places, but the workings are dry, and it stands well. Auger drills are used in mining. Operations are intermittent, depending on the demand.



California Ochre Mining Company's property, Knights Ferry, Stanislaus County, showing ochre on dump covered with sheet iron.

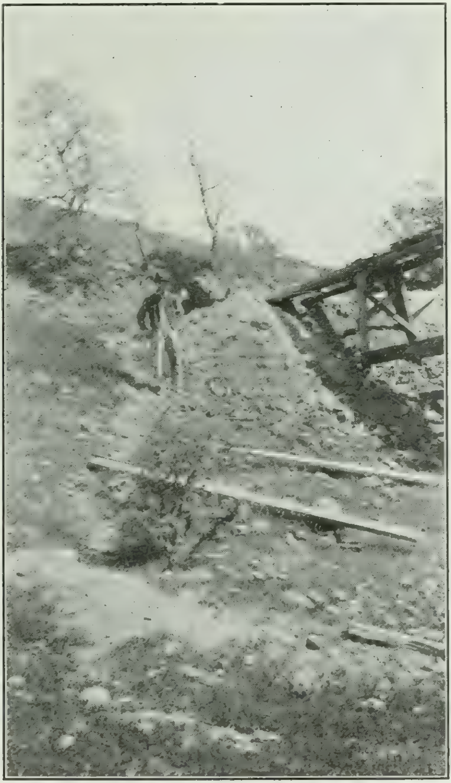
PETROLEUM.

Considerable interest has been taken in the oil possibilities of Stanislaus County, and operators have acquired leases for drilling purposes on both the west side of San Joaquin River and in the vicinity of Oakdale and Knights Ferry. Drilling started as early as 1920, but to date no producing well has been brought in.

Details relative to the geology and petroleum possibilities are contained in Bulletin 89 of the State Mining Bureau, and all field operations are reported in current issues of 'Summary of Operations, California Oil Fields,' published monthly by the Department of Petroleum and Gas of the State Mining Bureau.

No attempt was made to cover oil development in the present report. The reader interested in this subject is referred to the above publications and others listed below, which are devoted to it.

Bibl: State Mining Bur. Bull. 89; U. S. Geol. Survey Bull. 603.



Voyle Ochre Mine, Knights Ferry, Stanislaus County, California.

QUICKSILVER.

A wide belt of Franciscan rocks follows the trend of the Diablo Range from Alameda County southeasterly for many miles. Within this belt in western Stanislaus County there are a number of quicksilver prospects, from some of which the metal has been produced. At the time of visit (March, 1925) none of the properties in the county were being worked.

The Adobe Valley or Stanislaus Mine consists of 320 acres of patented land in Secs. 23 and 24, T. 6 S., R. 5 E. This mine was opened up in 1884. During the following four years a small amount of quicksilver was produced, since which time it has not been worked. Some work has been done by lessees on a quicksilver prospect in Sec. 31, T. 5 S., R. 5 E., owned by M. I. Crocker and K. D. Winship, of San Francisco. The same lessees also did some development work on the adjoining Newhall or Deer Park Mine, which comprises seven claims on Deer Park Creek in Sec. 32, T. 5 S., R. 5 E., but no metal was produced. The Gigax claims are located near the Newhall. They are undeveloped. The International Mine is in Sec. 3, T. 8 S., R. 6 E., on the south fork of Orestimba Creek, southeast of the Phoenix Mines. Some quicksilver was produced here prior to 1880, but it has been idle since. The Phoenix Mines includes the former Summit, Grayson, and Orestimba group, also referred to as the Hayward. The Summit-Grayson group is in Secs. 20, 21, 28, and 29, and the Orestimba group in Secs. 25, 35, and 36, all in T. 6 S., R. 5 E., 24 miles southwest from Patterson by a poor road. There is a good road to Livermore, 39 miles distant. There are seven patented claims, four mill sites, six unpatented claims, and 160 acres of timber land in the Summit-Grayson group, and 2300 acres of patented land in the Orestimba. This property was opened up in the 70's and sold to Alvinza Hayward about 1901. A 50-ton Scott furnace was built in 1902–3. The mine was re-opened the latter part of 1915 and operated until June, 1916, a period of high quicksilver prices. The ore is low grade and larger equipment and more extensive development are required to handle such ore.

> Bibl: State Mineralogist's Reports X, pp. 680, 681; XIII, p. 603; XIV, pp. 632, 633. State Mining Bur. Bull. 27, pp. 188, 189; Bull. 78, pp. 197–199. U. S. Geol. Survey Min. Res., 1915, Pt. I, p. 271.

Orestimba Mining Co. This is an incorporated company, with an authorized capitalization of $200,000. H. A. Wilder, 217 Tait Avenue, Los Gatos, California, managing director. The company owns a group of 22 claims in Sec. 28, T. 7 S., R. 6 E., about 25 miles south of west of Crows Landing. There is a poor road for 20 miles and then five miles of trail to the mine. The property was equipped during the war period with a 12-pipe retort, and a small production was made under the name of Palo Alto Mining Association. There is a shaft 75 feet deep, which is said to be in high-grade ore at the bottom. Magnesite also occurs on the claims, but it has only been slightly prospected.

SILICA.

There is a deposit of comparatively pure silica in ledge formation on Del Puerto Creek, about 12 miles west of Patterson. The road, which follows the grade of the former Patterson and Western Railroad, passes directly across the end of the formation.

Hammonds Property. Wm. N. Hammonds, of Patterson, has located Silica No. 1 Claim on the ledge, in Sec. 4, T. 6 S., R. 6 E. The ledge outcrops boldly, varying in width from 5 to 20 feet. It is composed essentially of pure white quartz. Two analyses of samples of the material are reported as follows:

(1) by George A. James Co.

Water	0.8%
Iron	None
Silica	99.2%

(2) by Smith, Emery and Co.

Silica	99.783%
Alumina	0.21 %
Iron oxide	0.007%

Only a small amount of development work has been done. Several tons of the material in lump form are piled on a loading platform beside the road. Should the Western Stockton Glass Plant resume operations, it is possible that it could be used by that plant.

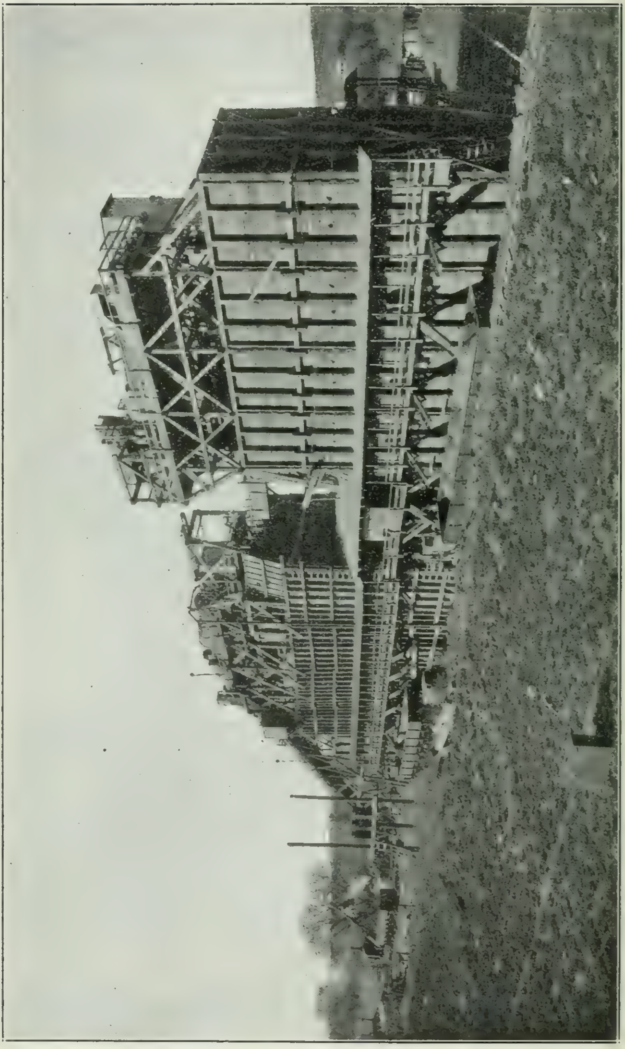
STONE INDUSTRY.

Crushed Rock, Gravel and Sand.

Atlas Rock Co. Alexander McMillan, president; Fred R. Beerman, secretary and manager; home office, 904 Commercial and Savings Bank Building, Stockton, California. The company was organized March 7, 1923, and owns 167 acres, covering the present Stanislaus River and older bench gravel deposits situated three miles east of Oakdale on the line of the Sierra Railway Company connecting with the Santa Fe and Southern Pacific at Oakdale.

A Marion drag-line steam-shovel, type 36, with 1½-yard bucket, excavates the material, which is transported on standard-gauge railroad equipment to the plant. The equipment consists of a 21-ton Vulcan locomotive and one twelve-yard Western wheeled-scraper dump car. The dump car is automatic in all its actions, dumping and locking by means of air operated by the engineer on the locomotive. The time required to dump 25 tons of material in the hopper, measured from the time the locomotive comes to a dead stop, the car dumping its load, righting and locking itself and ready to start back to the steam shovel for another load, is eight seconds.

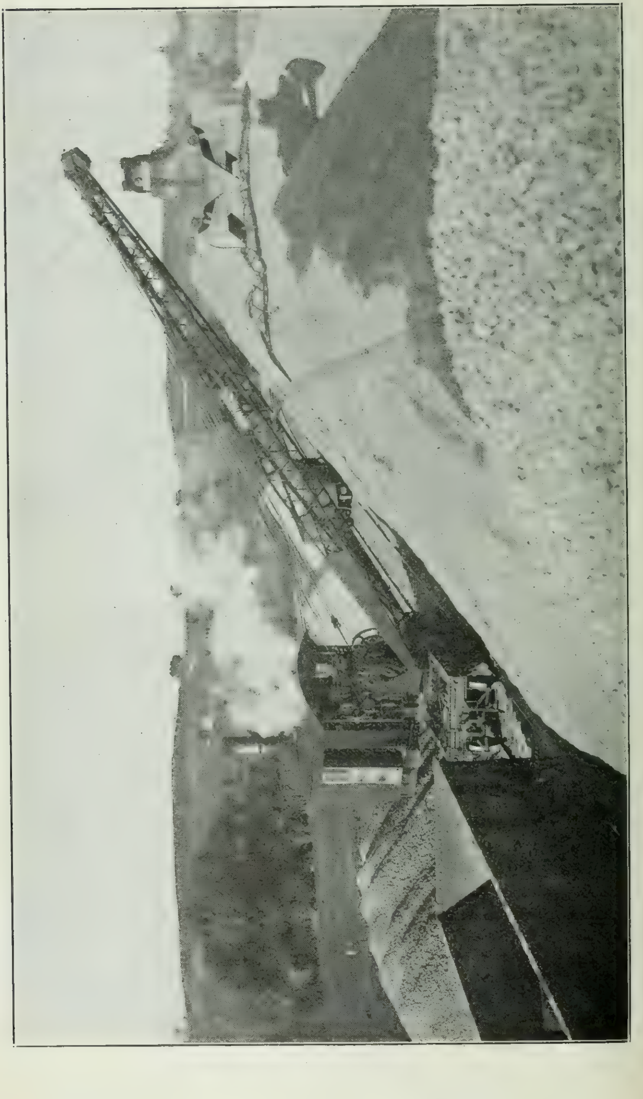
The material is fed from the bottom of the hopper to a 30-inch belt by means of a steel pan feeder. The belt, which is 251 feet between centers at an angle of 20 degrees, elevates the material to a 60-inch cylindrical screen 24 feet long. The first section of this screen is a scrubber, 6 feet long, having no perforations. Six 4-inch angles, spaced equi-distant and longitudinally in the inside of the scrubber, carry the material up on the inside of the screen, where it is dropped back; the force of the impact against the bottom of the screen loosening the silt and clay from the gravel. The primary washing takes place in this scrubber. Water is furnished by a 5-inch two-stage Byron-Jackson pump, which furnishes 800 gallons per minute under 20 pounds pressure at the nozzle end. A 6-inch cast iron pipe line



Plant of Atlas Rock Co., Oakdale, California. Photo by courtesy of Atlas Rock Co.

carries the water from the river to the scrubber. After it leaves the scrubber, water is sprayed over the material at various points. A final rewash is given just before the material is loaded on to the railroad cars for delivery. From the scrubber the material passes to the next section of the screen, which is 14 feet long, with 2¼-inch perforations. The material which is rejected on this section passes to the next section, which is 6 feet long and has 4-inch perforations. The material which passes through the perforations drops by gravity into the bin, which feeds a 36-inch Symons vertical disc crusher. The material rejected by this section drops into the bin which feeds a 14 x 18 inch Farrell jaw crusher. Surrounding the 2¼-inch perforated section is a 1⅜-inch dust jacket 14 feet long. The material passing through the 2¼-inch perforated section and rejected by the dust jacket passes into the 2-inch gravel bin. The material passing the 1⅜ inch dust jacket is passed by gravity into two sets of compound Gilbert screens. One of these compound screens consists of an inner conical, having ½-inch perforations and an outer conical having $\frac{5}{16}$-inch perforations. The materials passing through the 1⅜-inch dust jacket and rejected on the inner conical screen drops by gravity into the 1-inch gravel bin. The material passing through the inner conical and rejected by the outer conical drops into the pea gravel bin. The material passing through the two outer conical screens passes over two sets of Hungarian gold riffles which remove gold and platinum, leaving the sand, silt, and clay to pass on to two settling tanks, from which the silt and clay is drawn off and sluiced back into the river. One log washer conveys the sand from the bottom of one of the settling tanks into a concrete sand bin; another log washer conveys the sand from the bottom of the other settling tank to a 4 x 6 shaker screen, which produces a fine sand and a coarse sand from ⅛ inch to $\frac{5}{16}$ inch. In case it is not desired to produce plaster sand, the sand can be passed direct into the concrete sand bin.

The crushing plant consists of a primary and a secondary crusher as mentioned above. The crushed material from both crushers is fed to a bucket elevator belt, 7″ x 11″ x 18″ buckets with 71-foot centers and is elevated to a 42-inch cylindrical screen. The first section of this screen is six feet long with ⅞-inch perforations. Around this is a dust jacket six feet long, having ⅝-inch perforations. Material which passes through the ⅞-inch perforations and is rejected on the dust jacket drops into the ¾-inch crushed rock bin. The material which passes through the dust jacket drops into the dust bin. Materials which are rejected by the ⅞-inch perforated section pass on into a section 4½ feet long having 1¼-inch perforations. Products passing through this drop into the 1-inch crushed rock bin. The material rejected by this section passes on to a section six feet long having 1¾-inch perforations. The feed passing through these perforations drops into the 1½-inch crushed rock bin. Rock rejected by this last section passes on to a section six feet long having 2¾-inch perforations, and that passing through these perforations drops into the 2½-inch crushed rock bin. The materials rejected by this last section drop into a small bin which feeds a 20-inch conveyor belt which returns the rock to the bin feeding the Symons disc crusher.



Portion of stock piles, Atlas Rock Co., Photo by courtesy of Atlas Rock Co.

One of the features of this crushing plant is that any one of the sections of the cylindrical screens can be blanketed. This enables the production of any size crushed rock desired. It also enables the mixing of any one or all of the sizes in any one of the bins.

Another feature of the plant are two 30-inch mixing belts. One of them on the sand and gravel bunkers and the other on the crushed rock bunkers. The material is fed from the bunkers onto these belts by means of rack and pinion gates on the north side of the bunkers. This allows the mixing of two sizes of sand and four sizes of gravel in any desired proportions, or it allows the mixing of any one or all of the five different crushed rock products. The flexibility of the plant is excellent.

The cars are loaded direct from the south side of each bin when only one size of material is required. The time required for loading a 50-ton car is about four minutes. The capacity of the bunkers is 1000 tons of crushed rock and 1100 tons of sand, gravel, and cobbles.

Service Bros. Rock and Gravel Plant, Waterford, Stanislaus County, California.

The storage is handled by means of a 20-ton Brown hoist having a 50-foot boom and a 1½-yard bucket. The switching and moving of cars from the plant to the storage ground is performed by a 7-ton Plymouth gasoline locomotive. This has been found to be cheaper than using the locomotive crane, as the fuel consumed by the Plymouth, switching and moving cars for eight hours amounts to only ten gallons of gasoline.

The crane, steam shovel and Vulcan locomotive are equipped with oil burners. The Pacific Gas and Electric Company furnishes electric power to two Westinghouse and four General Electric motors, totaling 265 horsepower. The capacity is 1000 tons per day. Ffteen men are normally employed. N. F. Jones is plant superintendent.

County Pit. The county operates a small rock crushing and gravel screening plant on the La Grange Dredging Company's property, purchasing the dredger tailings, and utilizing the output on county work.

Service Bros. Pit. Service Bros., address, Ceres, or Waterford, California, are owners of a crushed rock, gravel, and sand plant, located at Waterford, on the Tuolumne River, 14 miles east of Modesto by paved highway. The material is excavated with a Sauerman 1¼-yard drag-line bucket, and dumped at the top of the plant. It passes through a revolving screen with 1½-inch holes, the oversize going to an Austin gyratory crusher. The crushed material passes over a dry screen, the oversize from this screen going to a Wheeler jaw crusher in closed circuit. Water for washing is obtained from an artesian well and pumped to the plant by a 3-inch centrifugal pump. There are seven bunkers from which trucks are loaded, and a railroad loading platform is located at Hickman, a station on the Southern Pacific, Oakdale branch, 1 mile distant. Electric power is used, 120 horsepower being required. Three men are employed at the plant. It has a maximum capacity of 700 tons in three 8-hours shifts.

LOS ANGELES FIELD DIVISION.

W. B. Tucker, Mining Engineer.

VENTURA COUNTY.

General Description.

Ventura County, created March 22, 1872, is one of the coast counties and lies between parallels 34° and 34° 50′ north latitude, having a coastline of about 50 miles. It is bounded on the north by Kern County, on the east by Los Angeles County, on the south by Los Angeles County and the Pacific Ocean, and on the west by Santa Barbara County. The total area is 1878 square miles. The population as shown by the census of 1920 was 28,724, and is now estimated at over 30,000.

The city of Ventura, originally called San Buenaventura, is the county seat, and is located on the shores of the Santa Barbara Channel. The cities of Oxnard, Santa Paula, and Fillmore are next in importance.

Ventura County is essentially an agricultural and stock-raising county. The increasing production of petroleum in the past few years, however, is rapidly bringing it forward on the list of mineral-producing counties.

Topography.

The northern portion of this county is characterized by the convergence of several important mountain ranges which make of it a high and rugged region. The more mountainous and rugged parts of Pine Mountain and Topatopa Mountain form what is considered one of the roughest and most inaccessible regions in California. Its lofty peaks range in elevation from 6000 to 9000 feet, the most prominent of which are Mount Pinos, elevation 8826 feet; Mount Frazer, 8026 feet; Pine Mountain, 7488 feet; and Alamo Mountain, 7371 feet. To the northwest extend the San Emigdio Mountains which form the connection between the Coast Range and the Sierra Nevada Mountains. To the west extend the San Rafael Mountains, while farther southward the Santa Ynez Mountains diverge from this group, running westward through Santa Barbara County.

The southern part of the county is characterized by a series of parallel folds, the axes of which lie east and west, forming low mountain ranges of no great continuity.

The principal valleys are Santa Clara, Ojai, Simi, and Las Posas.

The Santa Clara is a flat river wash, the level floor of which ranges in width from a mile at Piru to over five miles at Saticoy, where it opens out into the wide Oxnard terrace. It is bounded on the north by Sulphur Mountain and the more rugged mountains to the east that form the divide between it and the San Joaquin Valley. On the south it is bounded by the Santa Susana, Oak Ridge, and South Mountains.

The Ojai Valley lies north of the Santa Clara Valley and is separated from it by Sulphur Mountain. A low ridge across its length divides the valley into two parts, called Upper Ojai Valley and Lower Ojai Valley. The lower valley is drained by San Antonio Creek, which flows westward into the Ventura River, while the upper valley is drained by Sisar Creek, a tributary of the Santa Clara River.

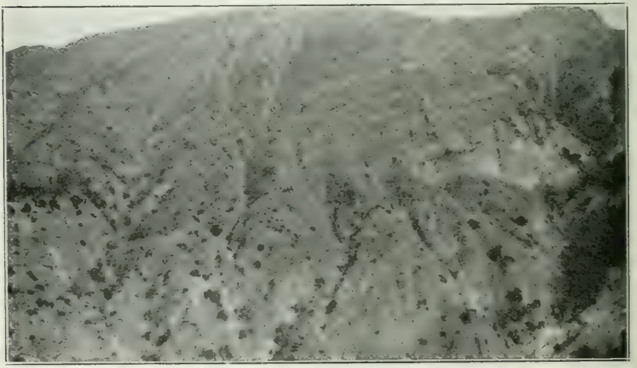
Simi Valley lies between the Oak Ridge Mountains on the north, and the Simi Hills on the south.

Las Posas Valley is a continuation of the same drainage basin, and westward joins the Santa Clara Valley, where it opens into the wide marine terrace.

Streams.

The two principal drainage systems of the county are the Santa Clara River and the Ventura River. Next in importance, but subordinate to these is Caleguas Creek, which drains the Simi and Las Posas valleys.

The Santa Clara River rises in Los Angeles County and flows westward 75 miles, emptying into the ocean south of the city of Ventura. Its principal tributaries from east to west are the Castac, Piru, Sespe, and Santa Paula creeks, all of which flow from the north. This stream runs almost dry in the summer, but in the winter becomes flooded, often doing great damage in the valley.



Outcrops of Coldwater Sandstone and Shale, Sespe Canyon, Ventura County.

The Ventura River receives its principal water supply from Matilija Creek, which rises on the southern slopes of Pine Mountain, and flows southward, entering the ocean at the city of Ventura. This river carries sufficient water throughout the year for irrigation purposes and to supply the city of Ventura.

Climate.

The climate in the southern portion of the county is delightful throughout the year, the summer heat being tempered by cool ocean breezes. Farther east in the valleys it becomes very hot during the dry season. The mountainous region in the northern portion of the county receives a coating of snow in the winter. The rainfall is confined to the winter and spring months.

Transportation.

The county is traversed by the Southern Pacific Railroad, with a branch line from Ventura to Ojai. At Montalvo, five miles east of Ventura, the main line divides into two branches, one going to Los Angeles via Las Posas and Simi valleys, the other through the Santa Clara Valley, joining the San Joaquin Valley line at Saugus.

With the exception of the higher mountainous areas, the county is easily accessible by roads, the main arteries being paved. Access to the gold and borax districts is obtained over the State Highway from Bakersfield to Los Angeles via Tejon Pass.

VENTURA COUNTY

Year	Gold, value	Petroleum		Natural gas		Asphalt and bituminous brick		Brick	
		Barrels	Value	M. Cu. Ft.	Value	Tons	Value	M.	Value
1880	$354	(2)							
1881	600								
1882									
1883									
1884									
1885									
1886									
1887									
1888									
1889									
1890	2,468								
1891	1,715								
1892									
1893									
1894		290,913	$367,822			248	$4 800		
1895		244,624	244,624			175	3,500		
1896		248,000	272,800						
1897		368,282	368,282						
1898		427,000	571,000			4,105	80,775	286	$2,228
1899	3,990	496,200	496,200			5,188	103,760	375	3,000
1900	2,562	443,000	398,700			1,466	31,670	230	1,700
1901	4,183	472,057	236,028			2,073	30,945		
1902	2,012	475,000	455,000			37	370		
1903	1,087	542,902	517,611			1,114	13,368	1,380	12,900
1904	2,700	518,000	465,682	1,800	$2,700	3,169	38,028		
1905	1,200	375,522	236,578	3,831	5,000	3,000	30,000	1,300	10,400
1906	(3)	311,000	155,500	3,500	1,000	3,700	37,000	1,675	11,650
1907		352,224	211,334	1,825	2,278			1,600	12,800
1908		289 625	217,219	3,625	4,531			200	1,500
1909		344,419	223,872	1,721	2,151			1,275	7,625
1910		492,147	319,898	545	681			1,190	36,945
1911		499,082	349,777	[4]29,580	2,958			900	5,100
1912		662,300	584,811	[4]55,068	4,163			550	3,575
1913		899,007	907,997	62,200	6,220			1,023	6,085
1914		943,929	991,125	100,000	6,000			449	3,102
1915		1,017,220	869,723	491,879	29,670			200	2,500
1916		943,499	985,956	806,540	133,867			(3)	
1917		996,501	1,313,388	1,033,564	152,550			(3)	
1918		1,339,342	1,982,226	858,457	150,885				
1919		1,685,073	2,755,094	1,038,574	252,240			(3)	
1920		1,989,681	4,988,130	1,521,448	214,280				
1921		2,167,326	5,869,119	2,127,476	360,443			(3)	
1922		2,933,685	5,236,628	3,583,818	536,502				
1923		3,610,794	4,109,084	4,162,318	470,261				
Totals	$22,871	26,378,354	$36,701,208	15,887,769	$2,338,380	24,275	$374,216	[3]12,633	$121,110

---

[1] Includes crushed rock, rubble, sand, gravel.

[2] Commercial production of petroleum in Ventura County began at least as early as 1874, in the Sulphur Mountain district, but detailed county segregations are not available for the early years.

[3] See under 'Unapportioned.'

[4] Quantity estimated, as only values given in reports of those years.

MINERAL PRODUCTION, 1880-1923.

Pottery clay		Sandstone		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value	Cubic feet	Value		Amount	Value	Substance
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	16,200	$16,500	----------	----------	----------	
----------	----------	33,200	20,000	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	250 tons	$6,500	Borax.
----------	----------	12,500	6,250	$35,279	----------	----------	
----------	----------	4,200	2,650	16,764	3,000 tons ----------	60,000 4	Borax. Silver.
----------	----------	3,200	1,600	22,500	50 tons	2,500	Mica.
----------	----------	1,750	900	25,100	3,500 tons 50 tons	140,000 3,800	Borax. Mica.
----------	----------	6,000	3,500	31,227	50 tons	3,000	Mica.
30	$45	2,300	1,380	60,490	----------	----------	
----------	----------	1,320	792	----------	----------	----------	
----------	----------	----------	----------	20,880	----------	----------	
560	1,680	----------	----------	15,406	----------	----------	
----------	----------	----------	----------	144,226	----------	830,853	Unapportioned, 1900-1909.
----------	----------	900	450	35,000	----------	----------	
1,900	1,900	4,658	2,325	750	----------	----------	
1,000	1,000	4,600	1,850	----------	----------	----------	
3,000	2,990	300	150	----------	----------	1,530	Unapportioned.
----------	----------	1,195	502	----------	----------	----------	
----------	----------	----------	----------	2,674	----------	200	Other minerals.
(3)	----------	(3)	----------	14,200	----------	1,407	Brick, clay, sandstone.
(3)	----------	(3)	----------	30,000	----------	2,072	Brick and sandstone.
----------	----------	(3)	----------	52,900	----------	300	Other minerals.
(3)	----------	(3)	----------	5,000	----------	4,500 190	Clay and clay products. Other minerals.
(3)	----------	(3)	----------	25,265	----------	500	Mineral paint and sandstone.
----------	----------	----------	----------	11,250	----------	3,985 472	Clay and clay products. Mineral paint and sandstone.
----------	----------	----------	----------	62,888	----------	1,060	Mineral paint and sandstone.
----------	----------	----------	----------	88,211	----------	12,128	Mineral paint and sandstone.
[3]6,490	$7,615	[3]92,323	$58,849	$701,010	----------	$1,075,001	

General Geology.

The rocks of the Ventura region fall into three classes: A metamorphic and granitic complex, which is commonly referred to as the 'basement complex,' a series of sedimentary rocks, and a series of igneous extrusive and intrusive rocks.

The metamorphic rocks are all of pre-Jurassic age and have been intruded by granite that is probably of the same age as that of the Sierra Nevadas, which is considered to be late Jurassic or early Cretaceous.

The sedimentary rocks, which in this region form the greater percentage, range in age from Upper Cretaceous to Recent.

The igneous rocks are practically all of the Miocene age and are mainly andesite, dacite, basalt, andesite breccia, and associated mud flows.

Mineral Resources.

Ventura County is the eighth county in the state in respect to the value of its mineral production for the year 1923, the exact figures being $4,679,684. The value of natural gas and petroleum amounted to $4,579,345; the remainder of the production amounting to $100,339 was from clay, crushed rock and gravel, mineral paint, and sandstone. The State Mining Bureau records of mineral production of the county date from 1880. Considerable gold was produced in the county previous to 1880, but of this there is no record. The production of borax from the time of its discovery in this county in 1898 to 1907 amounted to over 35,000 tons, valued at over $1,000,000.[1]

Among its other mineral resources are: Asphalt, borax, clay, diatomaceous earth, gypsum, limestone, mineral water, mineral paint, molding sand, phosphates, and sandstone.

---

[1] Gale, H. S., Borate Deposits in Ventura County, Cal.; U. S. Geol. Surv. Bull. 540, p. 434, 1912.

METALS.

GOLD.

The gold deposits of Ventura County are confined to the high mountainous region in the northeastern portion of the county embracing Mount Frazer on the north and McDonald Peak on the south, and known as the Piru District. The gold occurs in fissure veins in the mountains, which are composed largely of granite, syenite, schist, and slate, and in the gravels of the Piru drainage basin. It is said that the first gold discovered in California was that found in the placers of this district in 1841 by Andres Castillero. In 1842 gold was shipped from the placers to the United States Mint at Philadelphia.[1]

The deposits of gravel extend along the north side of Piru River from about 2½ miles above the mouth of Lockwood Creek to its head, and also in San Quelmo Canyon, a tributary of Lockwood Creek. Sluicing and rocking have been carried on intermittently here for many years. The gold is coarse and not much worn. The gravels lie in the form of terraces, extending in places to the top of the hills between Piru River and Lockwood Creek. These gravels were probably deposited by a Pliocene river heading more toward Mount Pinos than the present Piru.

Underneath the gold-bearing gravels is an older deposit of a different character, and barren of gold. It is more firmly cemented and perhaps belongs to the Miocene, which is strongly developed in this section.

In a similar manner, gravels overlie the Tertiary on the flanks of Frazer Mountain and Mount Pinos. On the former mountain they are gold-bearing. In later years a number of attempts have been made to work the gravels and some production is reported to have been made. The principal mining development in recent years has been confined to the quartz veins in the Piru and Snowy Mining Districts.

This region suffered from the disadvantage of being over fifty miles from the main lines of transportation. The State Highway from Bakersfield to Los Angeles via Tejon Pass makes the district much more accessible; also the recent development of Lockwood Valley will insure better roads for automobile travel, and should greatly aid in its development.

Arastra Flat Group of Claims. The group comprises two claims, Arasta Flat and Max B., located in the Piru Mining District south of the Frazer Mine. The vein strikes northwest and southeast, and is probably on the same lode as the Frazer Mine. Workings consist of several tunnels and opencuts. D. W. Maxy of Gorman, owner.

Big Four Group of Claims comprises three claims; Big Four, Hornet, and Lookout, located in the Piru Mining District, on the southern slope of Frazer Mountain. F. W. Spring of Ventura, owner.

Blue Bell Group of Claims. This group, comprising four claims known as Blue Bell, Red Bell, Silver Bell, and Yellow Bell, is located on Fitzgerald Mountain, 1½ miles southeast of Lockwood Valley, and one-half mile from Long Dove Creek. The course of the vein is north and south. The country rock is syenite and granite. Workings consist of tunnels and opencuts. Owners, C. H. Crandall and Dr. W. R. Colbert of Gorman.

---

[1] See Hittell's History of California, Vol. 11, p. 313.

Castac Mine is located on the ridge south of Piru River in the Snowy Mining District, about ten miles south of Gorman. Elevation is 4000 feet.

The property comprises three patented claims and two quartz claims held by location in Sec. 22, T. 7 N., R. 19 W., S. B. B. and M. Owners, Castac Mining Company; Chas. M. Dobson, president; A. B. Brant, secretary. Offices, 214 Citizens Bank Building, Pasadena, California.

The outcrop of the Castac vein can be followed for over 10,000 feet on the surface. The vein has a general northwest strike, and dips about 25° to the northeast. The width of the vein varies from two to four feet.

The country rock is granite and hornblende schist. The hanging wall of the vein is hornblende schist, and the footwall is granite.

The main tunnel is 600 feet above the river, and about 75 feet below the outcrop. The tunnel is driven S. 60° E. on the vein, a distance of 250 feet. Here the vein was cut off by a fault which strikes N. 50° E., and dips 60° NW. A drift was driven approximately 400 feet northeast on the fault, where the vein was encountered, and a drift run about 400 feet southeast on the vein. The vein has an average width of three feet. At 300 feet an ore shoot was encountered, which is said to have produced $35,000 in gold. It is said that 9000 tons of ore valued at $125,000 was milled from this level. Total amount of drifting and crosscutting on this level is 1000 feet. At 60 feet vertically below this tunnel is another tunnel with 1200 feet of underground workings. The ore developed is said to average $14.00 per ton. The quartz is free milling, with some iron pyrite.

An aerial tramway runs from the lower tunnel to the 5-stamp mill on Piru River. The mill was driven by water power. Idle.

Bibl: State Mineralogist Reports VIII, p. 683; XII, p. 315; XIII, p. 497; XV, pp. 759–760.

Contact Mine comprises three claims located on Fitzgerald Mountain, in Secs. 34 and 35, T. 8 N., R. 20 W., S. B. B. and M., six miles southwest of Stauffer. Elevation 6000 feet. Owners, Thomas and Richard Harris of Ventura.

The vein strikes north and dips 40° west, varying in width from a few inches to four feet. It is said to average 14 inches. It has syenite for a footwall, with a porphyry hanging wall.

The workings consist of three tunnels driven along the vein at different levels and connected by winzes. The main working tunnel is 1000 feet in length. The greatest vertical depth of the vein exposed below the outcrop is 700 feet. The property is being developed by the owners during the summer months.

Bibl: State Mineralogist's Report XV, p. 760.

Esperanza (Foley) Mine is on the western slope of Frazer Mountain, at an elevation of 7000 feet. Holdings comprise three claims. Owners, Chas. Seifert and Mrs. Elizabeth Seifert of Los Angeles. Under option to P. J. McLaughlin of Los Angeles.

Three parallel veins varying in width from a few inches to four feet occur in the granite. These strike N. 30° E., and dip 65° E. Workings consist of three shafts about 75 feet deep sunk on the different veins, and a tunnel 125 feet in length, which is being driven to connect with one of the shafts. The ore is free milling quartz with some pyrite and chalcopyrite. Equipment consists of a Western Engineering Company's mill. Two men are employed.

Bibl: State Mineralogist's Reports VIII, p. 682; XIII, p. 497; XV, p. 760.

Frazer Mine, located in 1867, was the first quartz mine worked in the Piru District. The property comprises two claims known as Frazer No. 1 and Frazer No. 2, and is located in Sec. 13, T. 8 N., R. 20 W., S. B. B. and M., on the southern slope of Frazer Mountain, at an elevation of 6500 feet. Owner, Miss Nannie Bicknell. Dr. C. P. Baggs, agent, Bradbury Building, Los Angeles.

The vein strikes northwest and is nearly vertical. The country rock is porphyry, gneiss, and talcose slate. The vein quartz is free milling, and contains a percentage of pyrite and chalcopyrite. The average value of the ore is said to have been from $15.00 to $18.00 per ton in gold.

Workings consist of seven tunnels driven on the vein at different elevations. These tunnels are from 40 to 500 feet in length. Total amount of underground workings is over 3000 feet.

In 1893 the mine was sold to the Frazer Mining Company of Los Angeles and operated until 1895, when operations were suspended, and have not since been resumed. This mine has been the largest producer in Ventura County. Reported production, $1,000,000.

Bibl: State Mineralogist Reports VIII, p. 682; XII, p. 315; XIII, p. 497; XV, p. 760.

Golden Bloom Group of Claims comprises three claims known as Golden Bloom, Lead Bloom, Crooked S., located in Piru District on Fitzgerald Mountain, about one mile south of the Contact Mine. Workings consist of short tunnels and opencuts. Owner, R. H. Colbert of Gorman.

Oro Fino Mine comprises two claims known as Oro Fino and Golden Era, located in the Piru Mining District south of Frazer mine. The vein strikes northwest and southeast. The average width is six inches. The country rock is granite. Workings consist of a shaft and short tunnels. Idle. Owners, A. F. Maxy and Chas. Maxy of Gorman.

Patton Mine is located in San Emigdio in the Piru Mining District. Workings are superficial. Owners, L. M. Patton, A. C. Patton, and Harvey Simpson of Ventura.

Red Rock Group of Claims comprises two claims known as Red Rock and Oak, which adjoin the Castac mine on the southeast. The claims are located in Sec. 22, T. 7 N., R. 19 W., S. B. B. and M., on the ridge between Piru River and Snowy Creek, eight miles north of Gorman. Elevation 4500 feet. Owner, William Snyder of Gorman.

The vein, which has an average width of three feet, is a continuation of the Castac vein. It strikes northwest, and dips 45° northeast.

Samples taken from different points along the outcrop are stated to have averaged $15.00 in gold. The country rock is schist.

Workings consist of a tunnel driven southeast 125 feet in the hanging wall of the vein, and a number of opencuts along the vein. One man is employed.

White Mule Group of Mines is on the western slope of Frazer Mountain, at an elevation of 6000 feet. The property includes the Bunker Hill and Fair View mines. Owner, Fred M. Wilcox, 328 O. T. Johnson Building, Los Angeles.

The vein strikes east and has a dip of 45° to the north. The average width of the vein is three feet. The quartz is heavily mineralized with pyrite, marcasite, and chalcopyrite.

On the White Mule Claim is an incline shaft 320 feet on the vein, and in a gulch south of this shaft, a crosscut tunnel has been driven 300 feet N. 20° E. with the intention of intersecting the shaft to drain the mine workings. The vein in the Bunker Hill claim was developed by tunnels and opencuts, most of which are caved.

Equipment consists of a gasoline hoist, pumps, and a blacksmith shop. Idle.

Bibl: State Mineralogist's Reports VIII, p. 682; XII, p. 316; XIII, p. 497; XV, p. 760.

MOLYBDENITE.

Small kidney-like deposits of molybdenite associated with copper ores ocur on Frazer Mountain and on McDonald Peak. James McDonald of Ventura has done some development work on a deposit located near the headwaters of Alder Creek, in the Snowy Mining District. Five claims have been located in Secs. 11 and 12, T. 6 N., R. 19 W. The country rock is granite.

PLATINUM.

Platinum is said to occur in the black sands of Lockwood Creek, but it is probably not present in commercial quantity.

NON-METALLIC MINERALS.

Asphalt and Bituminous Rock.

Extensive deposits of natural asphalt and bituminous rock are located in Brea Canyon, Cañon Del Diablo, Upper Ojai Valley, and Punta Gorda. The manufacture of asphalt by refining from crude petroleum has entirely replaced its production from the natural asphalt and bituminous rock deposits, and no work has been done on the various deposits for years.

Brea Canyon Mine is on the Cañada Larga Ranch, five miles north of Ventura. W. R. Welden of Ventura, owner. Narrow veins of bituminous rock are irregularly distributed over an area of 200 acres.

Bibl: State Mineralogist's Reports XIII, p. 44; XV, p. 754. Bull. No. 11, p. 48.

Cañon Del Diablo Mine is five miles northwest of Ventura on the Cañada de San Miguelito Ranch. The Taylor Estate, Ventura, owner.

A detailed report of this mine is given by Prof. E. W. Hilgard in the Tenth Annual Report of the State Mineralogist.

Bibl: State Mineralogist's Reports X, p. 763; XIII, p. 44; XV, p. 754.

Ojai Mine is in Secs. 3 and 10, T. 4 N., R. 22 W., S. B. B. and M., three miles west of Ojai in the Upper Ojai Valley. It is a deposit of decomposed sandstone and shales impregnated with heavy viscous bitumen which is seeping out of the bituminous shales. Undeveloped. Owners, J. S. Briggs and F. W. Ewing of Ventura.

Bibl: State Mineralogist's Reports XIII, p. 45; XV, p. 754. U. S. Geol. Surv., Twenty-second Annual Report, part I, p. 446.

Punta Gorda Mine, one-fourth mile north of the Southern Pacific Railroad at Punta Gorda, is in Sec. 1, T. 4 N., R. 25 W., S. B. B. and M. Asphaltum occurs in irregular veins in bituminous shales and clays which strike east, dipping steeply to the north. Owners, Henry D. Abbott and Thomas Gaynor of Punta Gorda.

Bibl: State Mineralogist's Reports XII, p. 33; XIII, p. 45. U. S. Geol. Surv., Twenty-second Annual Report, Part I, pp. 445–446.

Rincon Mine, one and one-half miles northeast of Punta Gorda, is a small deposit of bituminous sand. The mine has not been worked to any extent.

Bibl: State Mineralogist's Reports XII, p. 33; XIII, p. 45; XV, p. 754.

BORAX.

Colemanite, a borate of lime, was first found in Ventura County in 1898. The deposits are confined to a narrow belt along the eastern slope of Mount Pinos, in the extreme northeast corner of the county, and are classed among the few important borax deposits of the United States.

Three important mines have been developed in the district, and a considerable number of other holdings have been worked. These mines lie in the foothills, at the northern margin of Lockwood Valley, at the headwaters of Piru Creek. They are known as Columbus, Russell, and Frazier Mines. The mines are at present inactive, mainly on account of their distance from railroad transportation, and the development by the Pacific Coast Borax Company of large deposits near Ryan, Inyo County, which are more favorably situated in this respect.

The colemanite deposits occur within a series of bedded rock formations that have been extensively folded and faulted. In general, the trend of the outcrop is northeast, and the beds dip southeastward, away from the higher elevations in the Mount Pinos Range. The ore has not been found to any extent in outcrops on the surface.

Quoting Mr. Hoyt S. Gale, who made a detailed report on these deposits in Bulletin 540, U. S. Geol. Surv:

> "The borate-bearing beds lie in the sedimentary rocks closely associated with the basalt lava flows * * *
>
> "Massive ledges of limestone occur within these shale zones, particularly at the Frazier, Russell, and Columbus properties, and appear to be intimately associated with the principal ore bodies. * * *

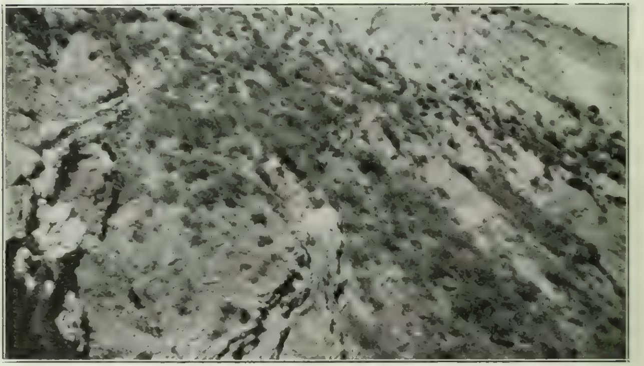
"The colemanite of the deposits of Ventura County occurs in roughly lenticular bodies which are extremely irregular in outline. The greater part of the ore is massive and crystalline, ranging from the transparent glassy crystals occurring here and there to milky-white masses. Most of the deposits are dark-gray to blackish color, probably owing to included impurities. In general the material would be described as a gray ore * * *

"The gangue of the colemanite ore in Ventura County is chiefly shale, with some limestone. The limestone is believed to be directly associated with the larger ore bodies. * * *

"The outcrop of the colemanite ore-bearing zones may be distinctly traced at least for a certain distance at the Frazier, Russell, and Columbus mines, and as these are the only occurrences of proved ore in depth * * *

"The chief characteristics of the outcrops seem to be the occurrence of gypsum, in stringer form, mainly interlaminated in the bedding of the fissile and crumpled shales, as a rule closely associated with beds of basaltic lava and in the principal ore bodies with ledges of massive travertine-like limestone. A characteristic of the associated shales that is conspicuous in some of the outcrops is the occurrence of small rounded calcareous concretions or 'buttons' * * * "

Columbus Mine comprises one patented claim of 160 acres, and ten unpatented claims located in Sec. 14, T. 8 N., R. 21 W., S. B. B. and M. The mine is the most northeasterly of the three developed mines of this district. The property was located in 1899 and operated continuously from 1902 to 1907. Sold to the National Borax Company in 1912.



Gypsiferous Shales Containing Colemanite. Stauffer, Ventura County.

This company erected bins and a sorting plant; also a rotary roaster six feet in diameter by sixty feet in length, jaw crusher, and screens were installed. Crude oil was used as fuel. Shut down in 1913 and has since been idle. Owner, United States Borax Company of West Virginia; C. B. Zabriskie, president.

Workings consist of a vertical shaft and numerous tunnels, all of which are caved.

The orebody is associated with massive limestone which outcrops in the gulch just above the mine. This ledge strikes northeast and stands nearly vertical. Production from this property began in 1902, and it is reported to have produced 9000 tons of crude ore up to 1907, after which the property was shut down. Practically all equipment has been junked and is being sold. Only assessment work is being done on the unpatented claims.

Bibl: U. S. Geol. Surv. Bull. 540, p. 448.

Frazier Mine is situated about midway between Seymour and Bitter creeks, being located southwest of the Russell Mine. It comprises twenty patented claims. Owned by the United States Borax Company; C. B. Zabriskie, president.

This mine was the first property located for borax in the district and has the most extensive underground development. The first locations were filed in 1898, and the work developed was undertaken soon afterwards. The mine first reported production in 1899, and was a producer until 1907, when operations were suspended. It is estimated that the total amount of crude ore shipped from this property has been about 25,000 tons.

The main workings are confined to Sec. 14, T. 8 N., R. 21 W., S. B. B. and M. The orebody was worked by a number of tunnels, the main one being 1700 feet long. These are driven along the course of the vein. The outcrop of the ore-bearing zone is represented by a thickness of 40 feet or more of thin bedded gypsiferous shale, which includes a ledge of fractured limestone some 12 feet thick. The orebodies are lenticular, often averaging 14 feet in width. The ore consists chiefly of whitish or grayish crystalline material which is a massive colemanite. All equipment on the property has been dismantled and sold.

Russell Borate Mine. Stauffer, Ventura County.

Bibl: U. S. Geol. Surv. Bull. 540, p. 443.

Russell Mine lies between the Columbus and Frazier Mines, in Seymour Canyon, and comprises 200 acres near the middle of Sec. 14, T. 8 N., R. 21 W., S. B. B. and M. Owned by the Russell Borate Mining Company, 624 California Street, San Francisco.

The workings consist of the main shaft 200 feet deep, with levels at 50′, 100′, and 200′. The 200-foot level is the main working level. It is 450 feet long running N. 16° W., and strikes the orebody at 319 feet. The ore developed on this level strikes N. 75° W., and dips 60° S. It has been developed on three sides by drifts. A winze was sunk from the 200-foot level and is said to be in ore to a depth of 50 feet.

The orebody in the mine is included in a section of shale and limestone interbedded in the basaltic flow rocks, the whole series having about a dip of 60° S. The orebodies are very irregularly distributed in the ore-bearing zone. The ore consists of glassy crystalline colemanite, mostly massive, varying from white to black in color, and is so mingled with limestone that it varies from nearly pure colemanite to limestone masses containing blotches of colemanite.

Equipment consists of 25-ton borax drying furnace, sorting bins, compressor, blacksmith shop, store, and other buildings. This is the only mine at which the equipment is kept in good condition. Idle.

Bibl: U. S. Geol. Surv. Bull. 540, p. 445.

Other Deposits and Prospects: Considerable prospecting has been done, and a great many claims have been located along the gypsiferous shales interestratified with basaltic lava flows that are exposed in the lower part of the canyon of Bitter Creek, west of the Frazier mine. It is reported that some ore was mined and shipped from this area. All workings are caved.

The borate-bearing beds which are exposed on the south side of Cuddy Canyon, at the foot of Frazer Mountain in Secs. 34 and 35, T. 9 N., R. 20 W., in Kern County, extend southwestward through Seymour Creek, Bitter Creek, and west of the North Fork of Lockwood Creek. A large number of locations have been made along this belt, and considerable prospecting has been done.

The shales are again exposed in the Upper Valley of Seymour Creek above Russell mine. A considerable amount of development work has been done in this area, but no ore developed.

In the past a number of prospect tunnels were driven along an outcrop of the gypsiferous shales on the Middle Fork of Lockwood Creek, and it is stated that several cars of colemanite were shipped from this point.

Some prospecting has been done for borate ores on the canyon of the North Fork of Lockwood Creek. It is stated that 160 tons of ore were shipped from a deposit on the west side of the creek. The prospects along this creek are in gypsiferous shales underlying the lava flows. These shales and lava flows outcrop westward from the North Fork for a considerable distance, probably as far as Dry Canyon.

CLAYS.

The clay deposits of Ventura County are mostly low-grade clays which include the adobe clays, common red brick and tile clays, and shales. The adobe clays are extremely strong plastic clays that slake readily when wet to a very sticky, pasty mass, and become hard on drying. A supply of fairly good clay and gray and blue shale is found at a number of points in Ventura County.

A low rounded hill located northwest of Montalvo Station, and west of the Los Angeles-Ventura Highway, contains beds of red vitrified clay. This clay is suitable for the manufacture of vitrified brick.

On the southwestern slope of Sulphur Mountain, west of Santa Paula Creek are beds of blue and gray plastic shale with an overburden of adobe that is suitable for the manufacture of common red brick and building tile. These deposits are being developed three miles north of the city of Santa Paula, on the Santa Paula-Ojai road.

Extensive beds of yellow and blue plastic shale are found in the hills east of the Ventura River, about two miles north of the city of Ventura. These beds of shale have been proved by drilling and excavating operations that show they extend north of the city limits of Ventura to Cañada de San Joaquin. Where these deposits are being developed the hill rises above the floor of the valley to an elevation of 500 feet. The clays are suitable for the manufacture of common red brick, roofing, building and drain tile.

An extensive belt of diatomaceous shale, which has a general strike to the northwest, is exposed on the Ventura-Ojai road between Cañada Larga Canyon and San Antonio Creek. These deposits may prove of commercial importance for the manufacture of light insulating brick.

Deposits of montmorillonite occur in a belt of diatomaceous shales on the Ventura-Ojai road five to nine miles north of Ventura. Montmorillonite is a clay-like variety of kaolin, containing a great amount of combined water. It is a form of halloysite, hydrous silicate of alumina. The material is quite soft, is white, gray, and red, has a soapy feel, and disintegrates when exposed to air. It is of commercial value for cleaning compound, softening of water, as a paint filler, and is used in the oil refineries as a purifier of oils.

BRICK AND TILE.

Only two producers of brick and tile are operating in the county.

Anderson & Hardison Pressed Brick Company; J. C. Hardison, president; G. A. Anderson, secretary, Santa Paula. The plant is three miles north of Santa Paula, on the Santa Paula-Ojai road. The clay used is a gray plastic shale, which is hauled from a hill west of Santa Paula Creek by a Fordson tractor and scraper.

The material from the storage hopper is elevated by a bucket elevator to a pulverizer, and is then passed over a 12-mesh incline screen. The minus 12-mesh material goes to the mixer; the oversize is returned to the pulverizer. From the mixer the material goes to a Berg Brick Press. From the press the bricks are loaded on hand trucks and transported to the yard, where they are burned in open kilns. Natural gas is used for fuel. The capacity of the plant is 15,000 brick per day. Ten men are employed.

Peoples Lumber Company, Ventura; J. M. Sharp, manager, has installed a new brick and tile plant two miles north of Ventura. The deposit being worked is a yellow and blue plastic shale, and is located in the hills east of the Ventura River. The Ventura Excavating Company delivers this clay from the clay bank where it is loaded into trucks by means of steam shovels and hauled a short distance, then dumped through a chute into a storage bin. The material from the bins is conveyed to a Potts disintegrator and rolls. From the rolls the ground product is elevated by bucket elevator to a piano wire screen. Through-size goes to a storage bin, oversize being returned to the rolls. From the bin the material is fed by automatic feeder to the pug-mill, and then it goes to the clay auger machine. From the clay auger machine the material passes to a revolving wire-cutting machine. Brick and tile is then transported to drying sheds, where they are dried by hot air.

The plant has a capacity of 20,000 brick and 25,000 tile per day. The brick and tile are burned in open kilns. Natural gas is used as fuel. The company manufactures common red brick, building and drain tile, and roofing tile. When operating to capacity fifteen men are employed.

Ventura Excavating Company, H. Love and J. McDonald, Ventura. The company is operating a clay bank two miles north of Ventura, on the hill east of the Ventura River. The deposit is a blue plastic shale, which has been opened up for a distance of about 500 feet. Two steam shovels are being operated, and the company, besides furnishing clay to the Peoples Lumber Company's brick plant, also sells the clay to oil companies operating in the Ventura field. The clay is being used for mud fluid in the drilling of the oil wells in the Ventura field.

Beds of Diatomaceous Earth, South Mountain, Ventura County.

Equipment consists of two steam shovels and four trucks. Ten men are employed.

DIATOMACEOUS EARTH.

South Mountain Deposit. Thinly laminated beds of yellowish white diatomaceous earth outcrop along the south slope of the mountain at an elevation of 2000 feet. These beds strike east and dip 60° N. Six placer mine locations consisting of 800 acres have been made along the exposures which are located in Secs. 19 and 20, T. 3 N., R. 20 W., and Sec. 24, T. 3 N., R. 21 W. Joshua Stockton and associates of Santa Paula are the owners.

These exposures are prominent and outcrop boldly for over two miles; and the beds have a probable thickness of 1000 feet. The owners have made a large number of opencuts along the outcrops, and a number of trails have been built, which also exposed the material. This material is white, gray, and yellow in color, and if closer to railroad transportation, would be of commercial importance.

GYPSUM.

Deposits of gypsum occur interbedded with diatomaceous shales on the low divide between Upper and Lower Ojai Valleys, on South Mountain and Oak Ridge. Owing to the association of the gypsum with clay and other impurities, the deposits have not been worked in recent years.

Ojai Gypsum Mine is three miles east of Ojai on a low divide that separates the two Ojai valleys. The deposit was worked in 1890 by the Tacoma Calcium Company, which sank a shaft and did considerable drifting. The gypsum developed in the workings is said to have contained numerous small stringers of black clay. This made hand sorting necessary, and the property was abandoned. Workings caved.

Bibl: State Mineralogist's Reports VIII, p. 688; Bull. 38, p. 288.
U. S. Geol. Surv. Bull. 223, p. 122.

South Mountain Deposit, owner, Joshua Stockton, Santa Paula. The deposit is located on the south slope of South Mountain at an elevation of 2000 feet, about four miles south of Santa Paula. The gypsum occurs interbedded with the diatomaceous shales, is soft and white, and massive but granular in texture. Undeveloped.

Sunset Plaster and Cement Company, Fillmore, worked a deposit of gypsum in Secs. 12 and 13, T. 3 N., R. 20 W., S. B. B. and M., four miles by road south of Fillmore. The gypsum occurs interbedded with diatomaceous shales which strike east and west with a flat dip to the north. The gypsum is white and massive.

This deposit is reported to have produced 10,000 tons, and was operated from 1911 to 1915. Idle.

LIMESTONE.

The only known deposits of limestone of commercial importance are beds outcropping in Matilija Canyon. The most prominent beds occur associated with clay and lime shales, southwest of Matilija Creek, and have a general east and west strike. This belt of limestone is two miles north of Matilija Springs, and the outcrops are exposed for a distance of several miles. North of Lyons Springs, on the north side of the Canyon is another prominent outcrop of limestone, which can be traced for several thousand feet. This material is said to be a natural rock cement.

Argilla Group of Claims is located in Secs. 23 and 24, T. 5 N., R. 24 W., S. B. B. and M., nine miles northeast of Ojai. Owner, E. Duryea, Hollingsworth Bldg., Los Angeles.

A massive bed of limestone striking east, and dipping south, is exposed on the south side of the canyon. This deposit has been recently sampled and the rock is said to be excellent natural cement. An analysis of an average sample as given by E. Duryea is as follows:

Silica	16.015%
Aluminum and Iron Oxide	5.320%
Lime	42.630%
Magnesia	1.119%
Carbon dioxide	34.190%

A good wagon road goes as far as Lyons Springs, and a good trail for the remaining distance.

Matilija Group of Claims comprises two claims located in Sec. 19, T. 5 N., R. 23 W., eight miles north of Ojai. Owner, Joshua T. Stockton and J. A. Barry of Santa Paula.

Beds of hard blue limestone are exposed along the top of the ridge north of Matilija Canyon, about one-half mile north of Lyons Springs. The outcrop of blue limestone strikes east and west, and is about 75 to 100 feet in thickness. This outcrop is exposed for a distance of about one-half mile. In a side canyon below the outcrop are exposures of lime shale. The rock is said to be an excellent natural cement. Undeveloped.

Ventura Cement Company Deposit. This deposit is one mile above Vickers Hot Springs and 12 miles north of Ojai. Holdings comprise 500 acres of patented land, located in Secs. 22, 23, 26, and 27, T. 5 N., R. 25 W., S. B. B. and M. Owner, Ventura Cement Company; Frederick Hartman, president; Alfred Roth, vice president; Frederick Sheldon, secretary, Ventura.

Outcroppings of beds of limestone are exposed in a side canyon south of Matilija Creek, one mile above Vickers Hot Springs. These deposits are undeveloped, but of such extent as to be of great potential value. The rock is stated to be an excellent natural cement. An analysis of this limestone has been made by the U. S. Testing Laboratory of St. Louis, and also by the Riverside Portland Cement Company.

Analyses of Natural Cement Rock.

Made by U. S. Testing Laboratory of St. Louis.

	Per cent	Per cent
Silica	10.82	8.68
Alumina	4.34	3.20
Magnesia	1.66	1.27
Carbon dioxide	36.47	37.89
Lime	47.13	48.80
Totals	100.42	99.84

FOSSILIFEROUS LIMESTONE.

Gillibrand Limestone Deposit, located five miles north of Santa Susana, a station on the Southern Pacific Railroad, in Secs. 17 and 18, T. 3 N., R. 17 W., S. B. B. and M. Owner, E. C. Gillibrand of Santa Susana.

Holdings consist of 200 acres, of which 100 acres, located in Sec. 18 is under lease to the *Ventura County Lime and Fertilizer Company* of Santa Paula, California. J. G. Leavans, president; Charles Wright, secretary.

A massive bed of fossiliferous limestone is exposed on the western slope of the Santa Susana Mountains, north of Simi Valley. The general strike of the marine shell lime belt is northeast, with a dip of 30° to the southeast. The exposure on the property is about 3000 feet in length, and has an average width of 300 feet. It is a decomposed shell deposit of lime. Analysis by Smith Emery Company:

CaO	54.64%
Co_2	42.86%
$CaCo_3$	97.50%
P_2O_5	07 to .33%
Insoluble	2.07%

The material is suitable for fertilizer, and has been used to some extent by citrus growers of the county.

MICA.

A deposit of muscovite occurs on the northeastern slope of Alamo Mountain, in Secs. 12, 13, and 24, T. 7 N., R. 20 W., S. B. B. and M. The country rock is granite, gneiss, and mica schist. The mica occurs in a feldspar gangue, between a granite hanging and a mica-schist footwall. It is said that some sheets of mica 3 x 4 inches were mined, but that the product was mostly scrap mica. The deposit was developed by the Mount Alamo Mica Company of San Francisco in 1907. Workings caved. Abandoned.

MINERAL PAINT.

South Mountain Deposit. Beds of soft red shales are exposed on the north slope of South Mountain. The thickness of the beds is about 60 feet, and they extend for several hundred feet. The material is of uniform brick red color, and pulverizes readily upon crushing, leaving little or no grit.

There was a small production from the deposit in 1923. The property has been in litigation.

MOLDING SAND.

Deposits of molding sand occur on a ridge north of Ventura. The sand is exposed in Buena Vista Canyon, and also in another canyon to the east on the McElrea Ranch. The sand is very fine-grained, has a good bond, and has been used in local foundries. A considerable tonnage has been shipped to Los Angeles.

Ventura Velvet Molding Sand Deposit is located within the city limits of Ventura, on a ridge south of Buena Vista Canyon, a mile north of the Southern Pacific Railroad Station, at Ventura. Owner, Charles A. Cole, Ventura, California. Holdings consist of 28 acres.

A bed of unconsolidated sandy loam and fine-grained sand, said to be 100 feet thick is exposed in the canyon. The quarry is 200 feet in length and 75 to 100 feet in height. The material is handled with scrapers to the bins, then screened through No. 4 mesh revolving screen, oversize going to a set of rolls.

Quality: The sand is very fine-grained. About 96 per cent of the sand will pass through 100 mesh, and 48 per cent through 200 mesh. The sand has a good bond.

Analysis.

Silica	66.25%
Iron oxide	8.75%
Aluminum oxide	12.75%
Calcium oxide	3.07%
Magnesium oxide	2.70%
Alkalies	2.40%
Loss in ignition and undetermined	4.33%
Total	100.25%

PETROLEUM AND NATURAL GAS.

Ventura County production of petroleum for the year 1923 amounted to 3,610,794 barrels valued at $4,109,084. In addition to this, natural gas was reported as valued at $470,261.

The producing oil fields occur in the south central portion of the county. The principal productive fields of the county are Barsdale, Ojai, Piru, Santa Paula, Sespe, Simi, South Mountain, and Ventura. For detailed description of the different oil fields of the county, see Bulletin No. 69, 'Petroleum Industry of California'; also State Oil and Gas Supervisor's Annual Reports.

Bibl: State Mineralogist's Reports VII, p. 101; VIII, p. 684; XII, p. 357; XIII, p. 585; Bulletins 11, 19, 32, 63, 69, and 89. U. S. Geol. Surv. Bulletins 309, 691m, 753. Summary of Operations, California Oil Fields, Vol. 5, No. 8; Vol. 10, No. 5.

Boulders of Brown Sandstone. Sespe Canyon, Ventura County.

PHOSPHATES.

Small deposits of white phosphates occur along the top of South Mountain, four miles south of Santa Paula, on the homestead of Joshua Stockton. These phosphates are in a thin strata scattered through the soft sandstone which crumbles readily in the hand. The owner reports that samples of the material sent to Los Angeles for analysis contained 5 per cent calcium phosphate. Undeveloped.

SANDSTONE.

The sandstone industry of the county has greatly decreased in the past few years, and only one quarry remains at which any stone has recently been quarried. For many years building stone was quarried from the large boulders and broken slabs of the Sespe brownstone in Sespe Canyon. This is a hard brown sandstone, uniform in texture and color and very resistant to weathering, as shown by the bold outcropping ledges and the fresh surfaces of the broken slabs. Massive beds of buff-colored sandstone outcrop two miles east of Santa Susana.

Beds of white siliceous sandstone outcrop in Matilija Canyon. Some building stone was cut from the boulders of this tough sandstone at Wheelers Hot Springs for local use.

Santa Susana Quarry is located in Sec. 16, T. 2 N., R. 17 W., S. B. B. and M., two miles east of Santa Susana. Massive beds of buff-colored sandstone were quarried by the Southern Pacific Railroad Company, and the stone used for rip-rap work along the road bed. The sandstone proved to be too soft for this purpose. Idle.

Block of Brown Sandstone. Sespe Canyon, Ventura County.

Beds of Brown Sandstone. Sespe Canyon, Ventura County.

Bibl: Bulletin 38, p. 327.

Sespe Canyon Brownstone Quarry is in Sec. 35, T. 5 N., R. 20 W., and Sec. 2, T. 4 N., R. 20 W., S. B. B. and M. George J. Henley, Sespe, owner.

The quarry is five miles north of Brownstone, a station on the Southern Pacific Railroad. The brown sandstone is exposed on both sides of the Sespe River. It is also exposed in the small tributary canyons such as Coldwater Canyon, east of the river. On the north side of the river the brown sandstone occurs in heavy, massive beds, with two sets of nearly rectangular joint planes, so that it lies in huge cubical blocks which have a gentle dip to the north and east. The brownstone series consist of sandstones, shales, and conglomerates, with a total thickness of 800 feet or more. On the hill west of the river about 800 feet above it, the shales have been eroded, exposing the top of the sandstones over a large area. A number of watercourses have cut deep tributary canyons into this hill, exposing the edges of sandstone layers from 15 to 20 feet thick, and in places forming perpendicular cliffs from 30 to 50 feet in height.

Good quarries of excellent brownstone could be opened at many places in this hill. The stone is a typical brownstone; the coarser-grained varieties have a rich purplish-brown color, and the finer-grained stone is a light reddish brown. Very little stone has been cut from the sandstone layers, and most of the material shipped has been quarried from boulders in Sespe Canyon. This material has been used in a great many buildings in different cities in California. Six thousand cubic feet of the stone were used in the Methodist Episcopal Church at Pasadena during 1924.

Massive beds of hard white siliceous sandstone are exposed on the north side of Coldwater Canyon. Only a small amount of stone has been quarried from this deposit. This white sandstone rests conformably on the brownstone. Only assessment work has been done.

Bibl: Bull. No. 11, p. 26; No. 19, p. 94; No. 38, pp. 142–145.

STONE INDUSTRY.

The rapid growth of the cities and towns of Ventura County has caused an increased demand for building materials, especially crushed rock, sand, and gravel. These materials are also used for construction of buildings, concrete and road work. A number of gravel and sand plants are under operation on the Santa Clara and Ventura Rivers.

CRUSHED ROCK, SAND, AND GRAVEL PLANTS.

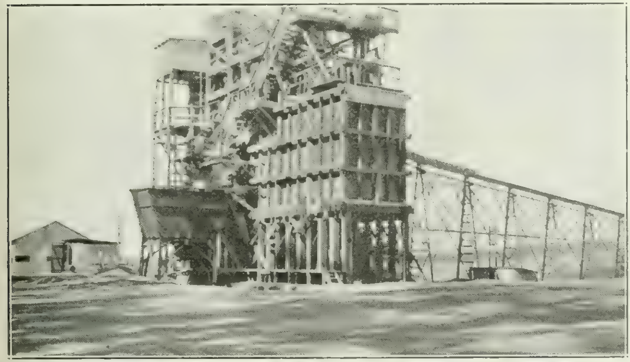
Saticoy Rock Company, A. G. Wright, president; W. F. Blackie, secretary; A. H. Stovall, manager, Saticoy. The crushing plant is located on the Santa Clara River, one mile southeast of Saticoy. The company controls 1000 acres along the river. The capacity of the plant is 550 yards per nine-hour day.

The gravel from the pits is loaded into a train of three side-dump cars, having a capacity of four yards each, by a Byers Model No. 10 bucket hoist. The cars are hauled by a Plymouth 7-ton gasoline motor to storage bins, where they are dumped over a grizzley, the bars being spaced ten inches apart.

All boulders that will not pass the grizzly are stored in the yard. From the receiving bins the 10-inch and finer gravel is transported by 30-inch belt conveyor to a No. 4 Universal crusher, where it is crushed to pass a 3-inch ring. The product from the crusher is elevated by bucket elevator to a Gilbert system of screens. The oversize material from the screening plant goes to a Weston Gyratory crusher, and is re-elevated to the screening plant. The material passes through Gilbert revolving screens, making the following products: 2½″, 1¾″, 1¼″, ½″ to ¼″, and sand. The sand goes to two 12-inch log washers.

The capacity of the storage bunkers for the product is 480 yards. Trucks are loaded by means of gates from each bin. Electric power is used to operate the plant, the total power being 137 horsepower. The cost of operation varies from 50 to 60 cents per yard. Eight men are employed.

Ventura Rock and Sand Company, W. T. Rodman, Ralph T. Ogilvie, and John Ward of Ventura, owners. The company operates two plants; one is located on the Santa Clara River, one-half mile south of Montalvo; the other on the Ventura River within the city limits of Ventura. No. 2 Plant. At the Montalvo plant the material is taken from the river and is hauled by scrapers to the hopper. It then passes through a No. 2 Universal crusher; the crushed material is elevated to a revolving screen, where it is screened dry. Products produced are 2″, 1½″, ½″–¼″, and sand. Capacity of the plant is 150 yards per nine-hour day. Six men are employed.



Saticoy Rock Company Gravel Plant. Saticoy, Ventura County.

No. 1 Plant. This plant is located 1½ miles east of the bridge on the Ventura-Santa Barbara Highway, on the Ventura River. Boulders and rock are hauled from the river bed by wagons to the hopper, where it passes to a No. 3 Austin crusher and is crushed to pass a 2-inch ring. The crushed product is elevated to revolving screens. The products made are 1½″, 1¼″, 1″, and ½″–¼″. The capacity of the plant is 50 yards per nine-hour day. A 20-h.p. motor drives the plant. Six men are employed.

OIL FIELD DEVELOPMENT OPERATIONS.

R. D. BUSH, State Oil and Gas Supervisor.

From January 25, 1925, to and including April 11, 1925, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Pacific Oil Co.	25	20	14	107	Coalinga
Penn Coalinga Petroleum Co.	1	20	14	14	Coalinga.
Premier Oil Co.	24	20	14	29	Coalinga
Zier Oil Co.	1	20	14	26	Coalinga.
KERN COUNTY:					
Elk Hills Development Co.	14	30	22	2	Elk Hills
Pacific Oil Co.	27	30	24	23	Elk Hills
Pacific Oil Co.	35	30	24	75	Elk Hills
Pacific Oil Co.	35	30	24	88	Elk Hills
Standard Oil Co.	31	30	25	Kern County Lease 1 21	Elk Hills
Union Oil Co.	26	30	24	Elk Hills 10	Elk Hills
Kern 29 Oil Co.	29	31	30	2	Kern River
Marland Oil Co.	16	28	27	Cauley 12	Kern River
Marland Oil Co.	16	28	27	Cauley 14	Kern River
C. E. and S. T. Vermilyea	2	29	28	11	Kern River
Wilmar Oil Co.	20	28	28	6	Kern River
Wilmar Oil Co.	20	28	28	7	Kern River
Oleo Fluo Co.	28	30	22	2	McKittrick
Standard Oil Co.	25	29	21	2	McKittrick
Standard Oil Co.	25	29	21	Weston 1	McKittrick
Washington Petroleum Corp.	8	30	22	4	McKittrick
Balboa Oil Co.	24	31	23	46	Midway
Balboa Oil Co.	24	31	23	48	Midway
Blair Oil and Refinery Co.	23	32	23	1-A	Midway
Boston Pacific Oil Co.	32	31	24	7-C	Midway
Formax Oil Co.	36	32	23	18	Midway
Formax Oil Co.	36	32	23	7-A	Midway
General Petroleum Corp.	32	31	24	10	Midway
Gilmore Oil Co.	27	31	22	1	Midway
Honolulu Consolidated Oil Co.	4	32	24	12	Midway
Honolulu Consolidated Oil Co.	6	32	24	24	Midway
Honolulu Consolidated Oil Co.	6	32	24	35	Midway
Honolulu Consolidated Oil Co.	6	32	24	55	Midway
Honolulu Consolidated Oil Co.	6	32	24	56	Midway
Honolulu Consolidated Oil Co.	4	32	24	61	Midway
Manley & McGinn	15	31	22	11	Midway
Midland Oilfields Co., Ltd.	24	31	23	15	Midway
Midland Oilfields Co., Ltd.	24	31	23	16	Midway
Midland Oilfields Co., Ltd.	24	31	23	17	Midway
Midland Oilfields Co., Ltd.	34	31	24	2-B	Midway
Midland Oilfields Co., Ltd.	34	31	24	Thornber B 1-A	Midway
Midway Pacific Oil Co.	24	31	22	10	Midway
North American Oil Cons.	32	31	24	2	Midway
North American Oil Cons.	32	31	24	3	Midway
North American Oil Cons.	30	31	24	17	Midway
North American Oil Cons.	30	31	24	18	Midway
North American Oil Cons.	30	31	24	19	Midway
North American Oil Cons.	30	31	24	20	Midway
Pacific Oil Co.	19	31	24	5	Midway
Pacific Oil Co.	19	31	24	7	Midway
Pacific Oil Co.	19	31	24	8	Midway
Pacific Oil Co.	19	31	24	12	Midway
Pacific Oil Co.	33	31	24	25	Midway
Pacific Oil Co.	19	31	24	47	Midway
Pacific Oil Co.	31	31	24	60	Midway
Pacific Oil Co.	25	31	23	67	Midway
Pacific Oil Co.	31	31	24	71	Midway
Pacific Oil Co.	1	32	23	98	Midway
Petroleum Midway Co., Ltd.	34	32	24	Dorothy 1	Midway
Pinal Dome Corp.	22	31	22	Wier 2	Midway
The Ransom Oil Co.	36	32	23	2	Midway
St. Helens Petroleum Co., Ltd.	1	32	24	Miller & Lux 1	Midway
Standard Oil Co.	31	31	23	Eagle Creek 31	Midway
Atlas Oil Co.	30	12	23	7	Sunset
B. B. & O. Oil Co.	28	12	24	27	Sunset
C. J. Berry	34	12	24	Hillside 13	Sunset
Frank O. Chittenden	18	11	23	1	Sunset
General Petroleum Corp.	12	11	24	59-A	Sunset

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
General Petroleum Corp.	12	11	24	69-A	Sunset
Midway Oil Co.	35	12	24	350	Sunset
Midway Oil Co.	35	12	24	375	Sunset
Midway Oil Co.	35	12	24	376	Sunset
Milham Exploration Co.	1	11	24	Milham Kern Sunset 1	Sunset
Standard Oil Co.	36	12	24	M.J.M. & M. 58	Sunset
Standard Oil Co.	36	12	24	M.J.M. & M. 59	Sunset
General Petroleum Corp.	28	11	20	4	Wheeler Ridge
Standard Oil Co.	28	11	20	Kern County Lease 2 17	Wheeler Ridge
Standard Oil Co.	28	11	20	Kern County Lease 2 18	Wheeler Ridge
Hitchcock & Cottle	21	30	21	1	Kern County
LOS ANGELES COUNTY:					
Associated Oil Co.	25	1	15	Fox Hills 101	Beverly Hills
Marland Oil Co.	3	4	13	Dominguez 7	Dominguez
Union Oil Co.	33	3	13	Callender 10	Dominguez
Union Oil Co.	33	3	13	Callender 11	Dominguez
Union Oil Co.	32	3	13	Callender 12	Dominguez
The United Oil Co. and Henderson Petroleum Corp.	3	4	13	Dominguez 5	Dominguez
Associated Oil Co.	7	2	14	Vickers 1	Inglewood
Associated Oil Co.	7	2	14	Vickers 2	Inglewood
Associated Oil Co.	7	2	14	Vickers 5	Inglewood
Associated Oil Co.	7	2	14	Vickers 8	Inglewood
Associated Oil Co.	7	2	14	Vickers 9	Inglewood
O. R. Howard & Co.	7	2	14	1	Inglewood
O. R. Howard & Co.	7	2	14	2	Inglewood
O. R. Howard & 3o.	7	2	14	3	Inglewood
Mohawk Oil and Gas Syn.	7	2	14	2	Inglewood
Mohawk Oil and Gas Syn.	7	2	14	3	Inglewood
Pan American Pet. Co.	17	2	14	Sentous 2	Inglewood
Pan American Pet. Co.	17	2	14	Sentous 7	Inglewood
Petroleum Midway Co., Ltd.	8	2	14	Moynier 1	Inglewood
Petroleum Midway Co., Ltd.	8	2	14	Moynier 3	Inglewood
Petroleum Midway Co., Ltd.	7	2	14	Smith 1	Inglewood
Petroleum Midway Co., Ltd.	7	2	14	Smith 2	Inglewood
Petroleum Midway Co., Ltd.	7	2	14	Smith 5	Inglewood
Petroleum Securities Co.	8	2	14	Cone 1	Inglewood
Petroleum Securities Co.	8	2	14	Cone 2	Inglewood
Petroleum Securities Co.	7	2	14	Cone 3	Inglewood
Petroleum Securities Co.	8	2	14	Cone 4	Inglewood
Petroleum Securities Co.	8	2	14	Cone 6	Inglewood
Petroleum Securities Co.	7	2	14	Lloyd 1	Inglewood
Shell Co.	8	2	14	Rindge 1	Inglewood
Standard Oil Co.	17	2	14	L. A. Inv. 1 4	Inglewood
Standard Oil Co.	17	2	14	L. A. Inv. 1 5	Inglewood
Standard Oil Co.	17	2	14	L. A. Inv. 1 6	Inglewood
Standard Oil Co.	17	2	14	L. A. Inv. 2 2	Inglewood
Standard Oil Co.	8	2	14	Vickers 1 2	Inglewood
Standard Oil Co.	17	2	14	Vickers 1 3	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 4	Inglewood
Standard Oil Co.	17	2	14	Vickers 2 1	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 2	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 3	Inglewood
Universal Consolidated Oil Co.	18	2	14	1	Inglewood
Wilshire Oil Co., Inc.	6	2	14	1	Inglewood
Atlas Drilling & Development Co.	24	4	13	O'Donnell 37	Long Beach
Hub Oil Co.	24	4	13	Roger 1	Long Beach
Hub Oil Co.	13	4	13	Woodward 1	Long Beach
Hub Oil Co. and Pugh-Miller Drilling Co.	24	4	13	Hunt 1	Long Beach
Hub Oil Co. and Pugh-Miller Drilling Co.	24	4	13	Wellman 1	Long Beach
A. T. Jergins Trust Co.	19	4	12	16	Long Beach
Pugh-Miller Drilling Co.	24	4	13	O'Donnell 38	Long Beach
Richmond Oil Co.	19	4	12	1	Long Beach
Shell Co.	29	4	12	Hutton Comm. 6	Long Beach
Union Oil Co.	30	4	12	Long Beach Comm. 12	Long Beach
McGinley Oil Co.	6	2	11	20	Montebello
McGinley Oil Co.	6	2	11	21	Montebello
Ed Mayhugh et al.	17	3	16	1	Newhall
Barnsdall Oil Co.	20	3	13	Rosecrans 5	Rosecrans

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Contd.					
E. L. Blanton	7	3	13	1	Rosecarns
C. C. M. O. Co.	2	3	14	Bilhorn 1	Rosecrans
E. E. Combs	7	3	13	2	Rosecrans
Courtney Petroleum Co.	7	3	13	15	Rosecrans
DeLendrecie Oil Well	7	3	13	Athens 1	Rosecrans
Dominion Oil Co.	7	3	13	Athens 1	Rosecrans
Dominion Oil Co.	7	3	13	Athens 3	Rosecrans
Elbe Oil Land Development Co.	7	3	13	1	Rosecrans
Elbe Oil Land Development Co.	7	3	13	2	Rosecrans
Elbe Oil Land Development Co.	7	3	13	3	Rosecrans
Walter H. Fisher Corp.	7	3	13	9	Rosecrans
Walter H. Fisher Corp.	7	3	13	10	Rosecrans
Walter H. Fisher Corp.	7	3	13	11	Rosecrans
Wm. E. Garner	7	3	13	1	Rosecrans
General Petroleum Corp.	18	3	13	Vaughn 1-A	Rosecrans
General Petroleum Corp.	18	3	13	Vaughn 2-A	Rosecrans
Bud Gerner	7	3	13	Bob Gerner 1	Rosecrans
George F. Getty, Inc.	7	3	13	Athens 4	Rosecrans
George F. Getty, Inc.	7	3	13	Athens 5	Rosecrans
George F. Getty, Inc.	7	3	13	Athens 6	Rosecrans
George F. Getty, Inc.	7	3	13	Athens 2-A	Rosecrans
J. Paul Getty	7	3	13	3	Rosecrans
Golden State Refineries, Inc.	7	3	13	Bydal 1	Rosecrans
Nathan W. Hale	7	3	13	1	Rosecrans
Henderson Petroleum Corp.	7	3	13	Athens 1	Rosecrans
Henderson Petroleum Corp.	7	3	13	Athens 2	Rosecrans
Hercules Gasoline Co.	7	3	13	2	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens Comm. 2	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens Comm. 3	Rosecrans
Marine Corp.	7	3	13	34	Rosecrans
Marine Corp.	7	3	13	35	Rosecrans
Marine Corp.	7	3	13	40	Rosecrans
Marine Corp.	7	3	13	42	Rosecrans
Marine Corp.	7	3	13	43	Rosecrans
Leland Mitchell	7	3	13	1	Rosecrans
Leland Mitchell	7	3	13	2	Rosecrans
Mohawk Oil Co.	7	3	13	Dixon 1	Rosecrans
Painted Hills Oil Assn.	7	3	13	A-1	Rosecrans
Pan American Petroleum Co.	1	3	14	Anderson Western 2	Rosecrans
E. A. Parkford	7	3	13	Athens 1	Rosecrans
Roy W. Perkins	7	3	13	2	Rosecrans
J. T. Robertson Co.	7	3	13	1	Rosecrans
Sentinel Oil Co.	7	3	13	Athens 4	Rosecrans
Superior Oil Co.	20	3	13	Maxwell Comm. 4	Rosecrans
Superior Oil Co.	20	3	13	Maxwell Comm. 6	Rosecrans
Superior Oil Co.	20	3	13	Maxwell Comm. 7	Rosecrans
The Twin State Oil Co.	7	3	13	1	Rosecrans
The Twin State Oil Co.	7	3	13	Green 1	Rosecrans
Union Oil Co.	17	3	13	Chandler 2	Rosecrans
Union Oil Co.	18	3	13	Howard Park 10	Rosecrans
Union Oil Co.	18	3	13	Howard Park 11	Rosecrans
Union Oil Co.	18	3	13	Howard Park 12	Rosecrans
Union Oil Co.	18	3	13	Howard Park 13	Rosecrans
Union Oil Co.	18	3	13	Howard Park 14	Rosecrans
Union Oil Co.	18	3	13	Howard Park 15	Rosecrans
Union Oil Co.	18	3	13	Howard Park 16	Rosecrans
Union Oil Co.	18	3	13	Howard Park 17	Rosecrans
Union Oil Co.	18	3	13	Howard Park 18	Rosecrans
Union Oil Co.	18	3	13	Howard Park 19	Rosecrans
Union Oil Co.	18	3	13	Howard Park 20	Rosecrans
Union Oil Co.	18	3	13	Howard Park 21	Rosecrans
Union Oil Co.	18	3	13	Trust 3	Rosecrans
Wilson, Gordon & Walker	7	3	13	1	Rosecrans
Shell Co.	11	3	11	Stubbs 1	Santa Fe Springs
C. C. M. O. Co.	8	4	14	Del Amo 16	Torrance
C. C. M. O. Co.	16	4	14	Del Amo 36	Torrance
C. C. M. O. Co.	16	4	14	Del Amo 42	Torrance
C. C. M. O. Co.	16	4	14	Del Amo 48	Torrance
C. C. M. O. Co.	16	4	14	Del Amo 54	Torrance
C. C. M. O. Co.	15	4	14	Torrance 74	Torrance
General Petroleum Corp.	30	4	13	Poggi 6	Torrance
General Petroleum Corp.	30	4	13	Poggi 7	Torrance
General Petroleum Corp.	30	4	13	Poggi 8	Torrance

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Contd.					
George F. Getty, Inc.	8	4	14	Torrance 24	Torrance
Marine Corp.	25	4	14	51	Torrance
Petroleum Midway Co., Ltd.	14	4	14	Carlson 2	Torrance
Petroleum Securities Co.	19	4	13	Kleinmeyer 10-B	Torrance
Petroleum Securities Co.	30	4	13	Kleinmeyer 11-B	Torrance
Petroleum Securities Co.	30	4	13	Kleinmeyer 16-B	Torrance
Selby & Root Co.	14	4	14	11	Torrance
Shell Co.	9	4	14	Fenger 3	Torrance
Shell Co.	9	4	14	Redondo Comm. 4	Torrance
Standard Oil Co.	13	4	14	Dominguez 12	Torrance
Standard Oil Co.	17	4	14	Ellinwood 2	Torrance
Standard Oil Co.	22	4	14	Marble Lease 2 3	Torrance
Superior Oil Co.	30	4	13	Torrance 59	Torrance
Superior Oil Co.	30	4	13	Torrance 60	Torrance
Superior Oil Co.	30	4	13	Torrance 61	Torrance
Superior Oil Co.	19	4	13	Torrance 63	Torrance
Van Alen Oil Co.	22	4	14	7	Torrance
Central Oil Co. of Los Angeles	23	2	11	75	Whittier
Whittier-Strong Oil Co.	22	2	11	3	Whittier
Antelope Oil & Gas Co.	11	7	12	2	Los Angeles County
Midway Gas Co.	8	3	14	Leuzinger 1	Los Angeles County
Russell Oil Co.	25	3	17	1	Los Angeles County
Shell Co.	11	3	11	Stubbs 1	Los Angeles County
Standard Oil Co.	23	2	12	Hadley 1	Los Angeles County
Union Oil Co.	10	2	15	Newlin 1	Los Angeles County
ORANGE COUNTY:					
Brea Canon Oil Co.	2	3	10	37	Brea Olinda
C. C. M. O. Co.	8	3	9	96	Brea Olinda
Shell Co.	1	3	10	Fisher 3	Brea Olinda
Shell Co.	2	3	10	Orange 3-A	Brea Olinda
Shell Co.	2	3	10	Pico 3-A	Brea Olinda
Birch & Royer	24	3	10	Nenno 1	Coyote Hills
General Petroleum Corp.	2	6	11	Dabney 4	Huntington Beach
Julian Petroleum Corp.	2	6	11	Fosnaugh Brown 1	Huntington Beach
Petroleum Midway Co., Ltd.	11	6	11	Brown 6	Huntington Beach
Shell Co.	2	6	11	Davenport 7	Huntington Beach
Southern California Drilling Co.	2	6	11	Riggle 3	Huntington Beach
Standard Oil Co.	12	6	11	Farnsworth 4	Huntington Beach
Standard Oil Co.	2	6	11	Huntington B 30	Huntington Beach
Standard Oil Co.	34	5	11	Huntington B 31	Huntington Beach
Standard Oil Co.	2	6	11	Huntington B 32	Huntington Beach
Standard Oil Co.	4	6	11	Huntington B 33	Huntington Beach
Standard Oil Co.	4	6	11	Huntington B 34	Huntington Beach
Standard Oil Co.	12	6	11	Thomson 6	Huntington Beach
E. S. Bruce	27	6	10	2	Newport
Interstate Oil Corp.	21	6	10	Mesa 2	Newport
John E. Otto	22	6	10	1	Newport
South Basin Oil Co.	28	6	10	5	Newport
Chicksan Oil Co.	32	3	9	3	Richfield
Craig Burns & Co.	36	3	9	1	Richfield
Standard Oil Co.	32	3	9	Kramer 2 19	Richfield
Union Oil Co.	15	3	9	Olinda 1	Richfield
Associated Oil Co.	12	5	12	Hellman 1	Orange County
Standard Oil Co.	1	6	10	Irvine 1	Orange County
SAN BENITO COUNTY:					
Henry Harper	--	--	--	1	San Benito County
SAN BERNARDINO COUNTY:					
The Arapahoe Petroleum Co.	8	15	8	1	San Bernardino Co.
SAN LUIS OBISPO COUNTY:					
Henry R. Dabney	--	27	10	Emericka 1	San Luis Obispo Co.
Lloyd Tevis	12	31	21	1	San Luis Obispo Co.
SAN MATEO COUNTY:					
A. & C. Oil Co.	17	6	5	1	San Mateo County
C. C. Julian & Co.	16	6	5	4	San Mateo County

OIL FIELD DEVELOPMENT OPERATIONS—Concluded.

Company	Sec.	Twp.	Range	Well No.	Field
SANTA BARBARA COUNTY:					
Union Oil Co.	--	9	34	Escolle 15	Casmalia
Palmer Union Oil Co.	26	9	33	8	Cat Canyon
General Petroleum Corp.	36	10	35	Bradley 3	Santa Maria
VENTURA COUNTY:					
W. C. Currier	34	2	20	7	Conejo
W. C. Currier	34	2	20	9	Conejo
J. A. Hess	4	1	20	2	Conejo
J. A. Hess	4	1	20	3	Conejo
Rio Virgin Oil Syn.	4	1	20	1	Conejo
Henry R. Dabney	33	5	18	Kaar 1	Piru
Temescal Petroleum Co.	4	4	18	Landers 2	Piru
Empire Oil Co.	13	4	21	E. P. 1	Santa Paula
Miller Oil & Refining Co.	1	4	20	1-A	Sespe
White Star Oil Co.	33	5	19	19	Sespe
Oak Ridge Oil Co.	18	3	20	Willard 17	South Mountain
Oak Ridge Oil Co.	13	3	21	Yale Richardson 4	South Mountain
Santa Paula Oil Co.	18	3	20	Santa Paula 15	South Mountain
Union Oil Co.	13	3	21	Caldwell & Snyder 1	South Mountain
Associated Oil Co.	27	3	23	Lloyd 15	Ventura
General Petroleum Corp.	28	3	23	Barnard 4-A	Ventura
E. J. Miley	12	3	24	Casitas 1	Ventura
Shell Co.	28	3	23	Edison 3	Ventura
Shell Co.	28	3	23	Edison 4	Ventura
Shell Co.	27	3	23	Gosnell 11	Ventura
Shell Co.	28	3	23	Gosnell 14	Ventura
Shell Co.	28	3	23	Gosnell 15	Ventura
Shell Co.	28	3	23	Taylor 8	Ventura

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

CALIFORNIA FOUNDRY SANDS.

In December, 1921, a Joint Committee on Molding Sand Research was organized by the American Foundrymen's Association and the Engineering Division of the National Research Council for the purpose of carrying on detailed tests and research work on all samples of sand thought to be suitable for foundry use. Samples were to be collected by the Geological Surveys of the various states and forwarded to the testing stations. Three stations were designated for making the tests, viz. Cornell University, Ithaca, New York, the University of Illinois, Urbana, Ill., and the U. S. Bureau of Standards, Washington, D. C.

It was understood that no tests were to be given to private parties in advance of their publication, and that both the American Foundrymen's Association, and the State Geologists should have the right to make the results of the tests public as soon as they desired through their official mediums of publication.

The California State Mining Bureau was invited to cooperate in this work so that foundrymen and producers of molding sand in California could take advantage of this opportunity to learn more of the qualities of sands found in the state. Steps were at once taken by the State Mineralogist to advise producers of the details of the plan. Twelve samples of foundry sand were accordingly collected by the State Mining Bureau from eight producers of such sands, and forwarded to the U. S. Bureau of Standards, Washington, D. C. Geological data concerning the deposits were at the same time forwarded to one of the Joint Committee's sub-committees, that on Geological Surveys, for inclusion in the final report. In order to facilitate the work, the following facts and suggestions were supplied by the committee. As some of those interested in the subject of molding sand may not see the complete report, these notes are included herein and follow in substantially the same form.

The investigation of the problem of molding sands was undertaken, not only with a view to standardizing the methods of testing them, but also to consider the topics of blended sands, the reclamation of old sands, synthetic sands, and the possible sources of supply.

Some foundries obtain their molding sand from nearby sources but in many cases the material is hauled several hundred miles from the pit to the point of consumption, and thus the freight adds greatly to the cost of material.

Furthermore there is danger of exhaustion of certain well-known deposits which have been drawn upon extensively to supply foundries over a wide territory.

The problem of interest to the foundrymen and geologic surveys is therefore two-fold: viz. to discover additional sources of supply, nearer, if possible, to points of consumption, and to discover deposits, which alone may not be suitable, but which can be used as ingredients of synthetic mixtures.

The molding sand resources of some states may seem well known, but this is only partly true, and moreover the fact that it is possible now to make artificial mixtures, which in many cases are equal to the natural ones formerly employed, opens up a field of usefulness for certain sands formerly regarded as worthless.

It seemed highly desirable, therefore, that a thorough and intensive study should be made of the sand, gravel, and loam deposits of the different states, and also of those high silica sandstones which could be used after crushing.

Character of raw materials. The sands used for foundry work are obtained from two kinds of rock: 1. Friable siliceous sandstone, and 2. Unconsolidated deposits of sand, gravel, or sandy loam.

The products obtained from these deposits are divisible into the following classes:

Molding Sand. The sand used for molding is composed of sand grains, and a bonding material. The grains are mostly quartz, but in part feldspar. Freedom from mica is desirable. The bond may be clay or hydrous iron oxide, and should be evenly distributed through the sand. The grain ranges from coarse to fine, depending on the kind of casting to be made. Fine sands may be roughly determined by feel and inspection. The bond may be roughly gauged by squeezing some moist sand in the hand, and then noting how the lumps resist breaking. The degree of bonding power is not in direct relation to the amount of clay which the sand contains, but rather upon the quality and amount of colloidal material present.

Core Sand. Core sand is usually composed of silica grains but some contain other minerals, of which feldspar is often abundant. Some core sands carry little or no bonding material, and it is necessary to add this. While a high silica content is desirable, the presence of some feldspar does no particular harm. Even small amounts of the other fusible impurities are not objectionable. The grains may be either rounded or angular.

The table gives the texture of a coarse core sand.

Molding gravels. Much very coarse strongly-bonded gravelly sand is used for foundry work. The gravel is always coarser than the run of graded molding sands, and it is rarely used for any other work than heavy castings. The larger pebbles may run approximately ¼-inch in diameter. The pebbles should be of silica, and the bond is clay. On account of the coarseness of the material the bond should be strong.

The table gives the texture of two molding gravels.

Steel Sand. This should consist of pure quartz grains, angular or rounded. It may be a natural sand or crushed sandstone. A uniform grain is desirable, and the average range of size is from 20 to 150 mesh. Steel sand is selected primarily for its refractoriness, and hence the impurities should be low.

The table gives the texture of a steel sand.

Fire Sand. This is a highly siliceous, refractory sand. It may contain some feldspar, and hence is not as pure as steel sand. There may also be a small percentage of bonding substance such as clay or hydrous iron oxide. The sand may sometimes run so coarse as to be called gravel. Fire sand is mixed with fire clay to make cupola and ladle linings, and for other refractory uses in the foundry.

Parting Sand. This is a pulverized fine quartz sand, which usually passes 100 mesh.

Sandstones. The sandstones used are in general those with little cement, which crush easily.

Sieve Tests of Molding Sands.

	1	2	3	4	5	6	7	8
On [1]20 mesh	39.7	32.	3.8	6.6	3.2	.7	0.	.3
On 40 mesh	30.4	34.3	9.8	15.2	5.0	.4	.2	1.2
On 60 mesh	13.3	9.8	22.8	13.7	11.4	4.9	6.0	25.6
On 80 mesh	1.3	1.1	6.5	9.2	13.6	6.5	9.4	10.1
On 100 mesh	.8	1.1	14.8	4.7	6.2	8.8	12.8	16.6
On 150 mesh	.4	1.3	13.7	8.4	22.4	22.8	26.8	10.8
On 200 mesh	.2	1.3	7.5	5.2	9.5	10.4	10.4	6.8
Fine silt 200 plus	.4	3.6	13.5	18.5	16.6	32.1	23.1	16.0
[2]Clay substance	13.5	15.5	7.6	18.7	12.1	13.4	11.3	12.6
Total sharp sand		84.5			87.9			
Bond		15.5			12.1			

	9	10	11	12	13	14	15
On 20 mesh	.3	0.	13.	7.	35.	4.7	----
On 40 mesh	.3	.3	79.4	35.5	34.1	48.1	----
On 60 mesh	.4	2.9	4.8	16.3	10.6	38.2	----
On 80 mesh	.2	1.6	.6	4.8	7.8	5.2	----
On 100 mesh	.6	2.6	.5	3.6	1.5	1.5	----
On 150 mesh	2.1	11.3	.4	2.1	1.8	1.0	10.5
On 200 mesh	6.1	9.3	.2	4.5	.4	.1	15.2
Fine silt 200 plus	74.1	57.9	.3	10.4	2.4	1.2	74.3
Clay substance	15.9	14.1	.5	14.8	5.8		
Total sharp sand			84.2				
Bond			14.8				

1. Millville gravel. 2. Gravel. 3. Coarse sand, No. 3 Albany. 4. Coarse sand, No. 3 Jersey. 5. Medium molding sand. 6. Medium sand, No. 1½ North River. 7. Medium sand, No. 2 Albany. 8. Nc. 2 North River. 9. Fine sand, No. 00 Albany. 10. Fine sand, No. 0 Albany. 11. Coarse core sand. 12. Facing sand. 13. Fire sand. 14. High silica steel sand. 15. Parting sand.

The points which it seemed desirable to include in a field investigation are the following:

1. Location of sand deposits, including relation to transportation routes.
2. Kind of formation containing sand.

---

[1] It makes no difference if the grains retained on 20 mesh sieve are ⅛ inch or larger. When they reach ¼ inch they are regarded as excessively large, and are usually removed from the molding sand by the molders when they riddle the sand through a ¾ inch ridde. A sand which in its natural condition contains 5% of ¼ inch pebbles should be rejected.

[2] Mr. Hanley, chairman of the sub-committee on standard tests states "that when the sand is hydrated iron oxide instead of clay, it generally acts the same as clay substance." "Clay substance" of course is a misnomer, but it is comprehensive to the foundryman in that it is bonding substance, and that is what he is interested in.

3. Dimensions of individual deposits.
4. Structural position or structure, and degree of uniformity of deposit.
5. Character and thickness of overburden.
6. Distribution of grains of different texture; that is
    - (a) Whether uniformly mixed or separated.
    - (b) If separated whether in patches which are due to crossbedded structure, or whether in regular beds.
    - (c) If in separated masses, thickness and extent of each, in order to indicate whether it is profitable to dig them separately, or whether the bank should be worked as a whole.
    - (d) Shape of grains, whether angular, subangular or round. (It remains to be decided which shape of grain gives the best results in foundry practice. From the standpoint of permeability and venting the less sharp the better.)
7. Approximate amount of bonding material, as determined by hand test, and whether of clay or hydrous iron oxide.
8. Mineral composition of grains, so far as this can be determined with a hand lens.
9. Calcareous or non-calcareous character, as determined by acid test.
10. Degree of consolidation, and nature of cementing material.
11. Presence of lumpy impurities, such as concretions or clay lumps; nature and size of same.
12. Method of working to be employed, whether as a bank or pit.
13. Method of taking sample, whether from face of bank, borings or otherwise.
14. Name of owner of property, and if deposits are being worked; for what purpose.

The fact that a sand is being used at the present time by some foundry is not to be regarded as conclusive evidence that all its uses are known: nor is the statement of one foundry that a sand is no good to be taken as definitely indicating its worthlessness.

References on Molding Sands. As some of those interested in the investigation of molding sands may desire to consult some articles on the subject, a selected list of references is given below.

References to Articles on Properties and Testing of Molding Sand.

1913 "American Foundrymen's Association Tests of Molding Sand"—by R. Moldenke, Trans. A. F. A. 21: 1-125.
1917 "Testing Molding Sands"—by L. H. Cole, Trans. Canadian Mining Inst. 20: 165-91.
1917 "Principles of Iron Founding"—by R. Moldenke, McGraw-Hill 278-305.
1917 "Refactory Furnace Sands"—by C. Jones. Trans. Faraday Society 12: 168.
1918 "Part II. Memoir on British Resources of Refractory Sands for Furnace and Foundry Purposes"—by P. G. H. Boswell, Taylor-Francis, London.
1919 "A Comparison of American and British Molding Sands"—by P. G. H. Boswell, Foundry, 47: 592-5.
1919 "Refractory Sands. Nature, Origin and Properties"—Hook Products, July & August, 1919, Vol. 22.
1919 "Practical Analysis of Molding Sand"—By Hayes. Iron Age 103: 739-41.
1919 "Molding Sands for Non-Ferrous Work"—by P. G. H. Boswell, Engineering 108: 418-20.
1920 "Testing and Judging Sands for Foundry Use"—by Hanley and Simonds. Foundry 48: 741-6, 772-4, 867-8 and 921-2.

References to Annual Reports on Molding Sands.

New York, Twenty-first Report of New York State Geologist, "Molding Sand, its Uses, Properties, and Occurrence," pp. 91-96, by Eckel, E. C.
Newland, D. H., Amer. Foundrymen's Association, 1915, (Albany Sand).
New Jersey, "Annual Report of State Geologist of New Jersey for 1904." pp. 189-246, by Kummell, H. B.

Wisconsin, Geological Natural History Survey Bulletin XV, "The Clays of Wisconsin and their Uses, Containing a Report of Midwestern Molding Sands," by H. Ries.

Virginia, Virginia Geological Survey, "Mineral Resources of Virginia," Molding Sands, by H. Ries.

Michigan, Geological Survey, "Foundry Sands," by Ries and Rosen.

Missouri Bureau of Geology and Mines, Second Series, Vol. 15.

Georgia Geological Survey Bulletin No. 37, "Sand and Gravels of Georgia," by Teas, L. P.

"Steel Molding Sand in Ohio," by J. A. Bownocker. A pamphlet issued by Ohio State Geological Survey—Reprinted from the Ohio Journal of Science, Vol. XXI, No. 8.

The results of the tests on the samples from California producers, as determined by the Committee, are given in the following table. The figures representing the highest bonding strength and greatest permeability are shown in black face type. It will be noted that these qualities vary with the per cent of water.

CALIF

Lab. No.	Locality	Grade if used	On 6	On 12	On 20	On 40
1	Pacific Grove, Monterey County	Core	0.00	0.00	0.00	11.11
2	Pacific Grove, Monterey County	Core	0.00	0.00	1.56	58.09
3	Ventura, Ventura County	"Velvet" molding sand	0.00	0.00	0.26	0.31
4	Riverside, Riverside County	Molding	0.00	0.65	1.75	1.72
5	San Diego, San Diego County	Molding	0.00	0.25	1.03	2.38
6	San Diego, San Diego County	Molding	0.00	0.00	0.20	0.82
7	San Diego, San Diego County	Molding	0.00	0.00	0.12	0.25
8	San Diego, San Diego County	Molding	0.00	0.00	0.07	0.05
9	4 miles north of Corona, Riverside County	Molding	0.00	0.00	1.43	5.78
10	4 miles S. W. of Corona, Riverside County	Molding	0.00	1.46	3.58	11.84
11	Ben Ali Siding, Sacramento County	Molding	0.00	0.00	2.71	13.11
12	Decoto, Alameda County	Molding	0.00	0.00	0.00	6.38

*Black-face figures represent the best developed bond strength and permeability.

ORNIA.

On 70	On 100	On 140	On 200	On 270	Thru 270	Clay subs	Total	Dye adsorp.	Water, per cent	*Bond strength	*Permeability
87.07	1.74	0.03	0.04	0.00	0.00	--------	99.99	74	0	----------	242.83
40.26	0.02	0.00	0.00	0.00	0.00	--------	99.93	72	0	----------	460.07
0.54	0.39	0.44	9.26	0.11	0.59	88.17	100.08	1,672	4.7	----------	7.49
									6.9	149.95	**8.81**
									8.5	**152.53**	8.71
									10.6	149.74	--------
2.11	1.42	0.44	15.98	1.15	1.36	73.35	99.93	1,440	4.4	----------	5.25
									5.7	180.44	**6.14**
									7.6	**187.90**	5.63
									9.8	184.20	--------
6.27	2.67	0.20	19.44	0.27	5.86	61.63	100.00	2,736	3.3	199.48	--------
									4.0	**210.59**	--------
									6.0	179.73	11.14
									8.2	174.60	11.77
									9.7	----------	**13.28**
									11.7	----------	10.86
3.28	2.05	1.28	2.76	0.12	0.98	88.60	100.09	5,136	6.4	169.38	2.66
									8.6	187.76	3.16
									9.9	**193.55**	3.32
									11.7	----------	**4.09**
									12.1	186.75	3.98
0.61	0.49	0.13	11.96	0.39	5.62	80.41	99.96	4,104	5.7	174.58	5.00
									7.8	176.81	5.61
									10.0	**177.14**	7.06
									11.7	158.20	**7.86**
									12.3	----------	7.29
0.14	0.23	0.23	21.93	0.05	5.23	72.02	99.95	2,840	3.1	128.88	9.72
									4.1	**130.96**	10.43
									5.8	128.84	**11.83**
									8.0	124.15	10.06
19.84	11.23	2.11	21.49	0.68	1.79	35.54	99.89	1,008	6.0	122.61	14.00
									7.9	**146.10**	**15.30**
									9.9	141.40	15.26
23.27	9.75	1.85	18.11	0.12	2.97	27.05	100.00	1,672	5.7	140.65	11.94
									7.8	141.40	16.25
									9.9	149.87	**16.34**
									11.6	**151.59**	14.15
									11.8	136.40	--------
16.45	4.33	0.21	6.04	0.00	0.00	56.05	98.90	1,040	------	----------	64.75
									2.00	----------	56.13
									3.9	----------	44.63
									5.6	208.40	19.16
									7.9	**215.43**	15.24
									10.5	161.96	0.44
6.38	5.71	8.38	18.46	0.01	1.00	59.55	99.98	1,440	6.1	206.30	3.68
									7.8	**215.49**	4.46
									10.5	190.80	**5.85**
									13.0	----------	4.30

ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Personnel.

There have been no changes of personnel to be noted, since the January quarterly went to press.

New Publications.

During the quarterly period covered by this issue the following Bureau publications have been made available for distribution:

Mining in California (quarterly), January, 1925, being Chapter No. 1 of State Mineralogist's Report XXI. Price 25 cents.
Summary of Operations, California Oil Fields: Vol. 10, Nos. 4, 5, and 6, October, November, and December, 1924, respectively.
Commercial Mineral Notes: Nos. 22, 23, 24, 25. January-April (inc.). These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale,' issued in the form of a mimeographed sheet, monthly. It is mailed free of charge to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains, in addition to its correspondence file, a mine report file which includes reports on some 7500 mines and mineral properties in California. Also, there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the period covered by this quarterly report, there were 2792 letters received and answered at the San Francisco office alone, covering almost every conceivable phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Deputy State Mineralogist.

STATISTICS.

California continues to produce commercially, as for some years past, more than fifty different mineral substances (the number reached 54 in 1923, which will probably be exceeded in 1924, when all the returns are in), the total annual value of which for 1924 as shown in the January issue of MINING IN CALIFORNIA (see page 123, *ante*) was estimated at $358,745,000.

At the present writing (May 1st), reports are in hand from most of the producers. Data for several substances are now complete and have been compiled, being presented herewith.

The information at hand indicates that there was no production in California during 1924 of the following substances, which have at one time or another in the past been on the active list here: Antimony, barytes, bismuth, cadmium, fluorspar, graphite, mica, molybdenum, serpentine, slate, strontium, and tin. There was production by a single operator in each, of the following: Andalusite, arsenic, calcium chloride, and sulphur, the figures for which will have to be combined under the 'unapportioned' item in the final report. The output of arsenic was the first in commercial quantity, of record in California. In addition to the above, there are potential deposits of ore of the following which have not as yet yielded a commercial output: Aluminum, cobalt, nickel, and vanadium.

ASBESTOS.

In 1924, a total of 70 tons of crude asbestos ore and fibre valued at $4,750 was shipped from Californian properties, being an increase over the 20 tons and $200 reported in 1923. This was mainly due to the shipments of short-fibre chrysotile from San Benito County to the Orient. The 1924 figure also includes amphibole asbestos utilized in magnesite composition flooring.

The future of asbestos mining in California is dependent largely upon the development of uses in quantity for the short-fibre mill grades, and for the amphibole variety. There are apparently large resources of such material that can be made available. Some spinning-grade fibre has also been found in this state, notably in Nevada, Calaveras, and Monterey counties, but the commercial yield to date has been small.

BITUMINOUS ROCK.

Small amounts of bituminous rock are still occasionally used for road dressing in those districts adjacent to available deposits, though the manufacture of asphalt at the oil refineries has almost eliminated the direct use of the native material. During 1924, a total of 6040 tons valued at $14,922 was shipped from quarries in Santa Barbara and Santa Cruz counties, compared with 2945 tons and $11,780 in 1923.

This material is essentially an uncemented sandstone which is saturated with and held together by a natural asphaltic constituent probably the residue from the evaporation of a crude petroleum deposit.

BORATES.

During 1924, there was produced in California a total of 93,273 tons of borate materials, compared with a total of 118,601 tons for the year 1923. The material shipped in 1924 included crude and selected colemanite ore from Inyo and San Bernardino counties varying from 18.6% to 26.9% anhydrous boric acid ("A.B.A."), also crystallized borax recovered by two plants from evaporation of brines at Searles Lake in San Bernardino County.

As the crude ore is not sold, as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have re-calculated the tonnage to a basis of 40% A.B.A. This is approximately the average A.B.A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Re-calculated as above, the 1924 production totals 52,070 tons valued at $1,599,149, a decrease from the similar figures for 1923 which were 62,667 tons and $1,893,798.

CEMENT.

Cement is the most important single structural material in the mineral output of this state. During 1924, there was produced a total of 11,655,131 barrels, valued at $23,225,850 f. o. b. plant. This is an increase of 829,726 barrels over the previous record figure of 10,825,405 barrels in 1923; but a decrease of $2,773,353 from the 1923 value of $25,999,203. The lower sales prices prevailing in 1924 were due to the competition of foreign cements brought over in ballast and dumped onto our local markets duty-free. There is no import duty on this foreign cement, the bulk of which came from Belgium.

As in the preceding three years, the output came from nine operating plants in seven counties, and in 1924 employing a total of 3081 men. The three plants in San Bernardino County made a total of 4,354,119 barrels valued at $7,571,370, the balance of the state's product coming collectively from a single plant in each of the following counties: Contra Costa, Kern, Riverside, San Benito, Santa Cruz, and Solano. For 1925, the new plant of the Pacific Portland Cement Company at Redwood City, San Mateo County is operating, and utilizing marine shells as a source of calcium carbonate. The Yosemite Portland Cement Company is building a plant at Merced, and will use limestone from a deposit on the Merced River in Mariposa County.

CHROMITE.

Chromic iron ore, or chromite, to the amount of 250 short tons, re-calculated to a basis of 45% Cr_2O_3, valued at $4,500 f. o. b. rail-shipping point was sold in California during the year 1924. This was principally of ore that had been mined during the World War period, but not then sold. It is hoped that the development of the steel industry and the resumption of copper smelting on the Pacific Coast may create some demand for California's chromite, but the outlook for the immediate future is not encouraging.

DOLOMITE.

The production of dolomite for the year 1924 totaled 28,843 tons valued at $81,271 being a decrease from the 69,519 tons and $142,615 of 1923, and came from a total of eight quarries in Inyo, Monterey, San Benito, and Tuolumne counties. The decrease was due mainly to a falling off of shipments from Inyo and Monterey counties. The material shipped was utilized for steel-furnace lining, manufacture of CO$_2$, flux, burned dolomitic lime, for stucco dash-coat, and terrazzo.

FULLER'S EARTH.

The production of 5290 tons valued at $67,295, here credited to 1924 as 'fuller's earth' is in reality colloidal clay of the montmorillonite class (sold under such local names as 'bentonite', 'otaylite', shoshonite', derived from the locality where found). Because of its being utilized for clarifying, filtering, and cleanser purposes, most of it in petroleum refining, we have placed it for the purposes of this statistical report, under the 'fuller's earth' heading. After all, the practical test of a fuller's earth is not so much chemical, as a practical, physical one; that is, its physical capacity to absorb basic colors and to remove these colors from solution in animal, vegetable, or mineral oils, also from water.

The 1924 output above noted is an increase over the 3650 tons and $55,125 credited to the year 1923.

GEMS.

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to the widely-scattered places at which stones are gathered and marketed for the most part in a small way. The materials reported in 1924 totaled $4,800 in value, compared with $13,220 in 1923; the decrease being due mainly to less activity in the tourmaline district of San Diego County.

The following table shows the distribution of rough, uncut gem and jeweler's materials during 1924:

County	Value	Kind
Butte	$225	Diamond, topaz, sapphire.
San Diego	1,925	Kunzite, tourmaline, spessartite and pyrope garnets, hyacinth, pink and aquamarine beryl, quartz.
Calaveras	*2,650	Quartz crystals.
Imperial		Dumortierite.
San Mateo		Jasper.
Total value	$4,800	

*Combined to conceal output of a single operator in each.

GYPSUM.

During 1924, one operator each in Imperial, Riverside, and San Bernardino counties produced a total of 25,569 tons of gypsum valued at $53,210 compared with 86,410 tons worth $188,336 in 1923. The material was utilized mainly in cement manufacture as a retardant, for hard-wall plaster, and for fertilizer. The considerable drop from the record figure of 1923 was due to smaller shipments from both Imperial and San Bernardino counties. The property of the Imperial Gypsum and Oil Company in western Imperial County has been taken over by the Pacific Portland Cement Co., Consolidated, and there is promise for a considerable increase in output.

LITHIA.

Lithia mica, lepidolite (a silicate of lithium et al) utilized in the manufacture of artificial mineral water, fireworks, glass, etc., has been mined in San Diego County since 1899, except between 1905 and 1915. Some amblygonite, a lithium phosphate, is occasionally also obtained from pockets associated with the gem tourmalines. In 1924 a total of 109 tons valued at $2,269 was shipped, in which was included a small tonnage of amblygonite. The lepidolite was utilized in glass manufacture.

MAGNESITE.

The production of magnesite in California during 1924 amounted to a total of 67,236 tons of crude ore valued at $900,183. Only a small part of it was sold 'crude,' however, as it is practically all shipped in the calcined form. The reports at hand show a total of 29,235 tons shipped calcined, of which 2925 tons were dead-burned and sold for refractory purposes, the balance going to the plastic trade. From 2 to 2½ tons of crude material are mined to make one ton of calcined. The 1924 output is a slight decrease both in quantity and value from the 1923 figures of 73,963 tons crude valued at $946,643. The average of the values reported for 1924 is $13.40 per ton as against $12.80 in 1923.

The more important producing properties in 1924 were: Maltby No. 1 (Western Magnesite Development Co., operated under lease by C. S. Maltby), on Red Mountain, Santa Clara County: and the Sierra Magnesite Company's group near Porterville, Tulare County; followed in order, by the Sampson Peak Mine (Maltby No. 3), San Benito County; California Magnesia Company (old Harker mine) at Porterville; and Maltby No. 2 in Chiles Valley, Napa County. Lesser amounts were reported mined in Fresno and Stanislaus counties.

MAGNESIUM SALTS.

The production of magnesium chloride and sulphate in California during 1924 totaled 4823 tons, valued at $145,883, an increase both in quantity and value over the 1923 figures of 3662 tons and $116,031. This was nearly all chloride, sold for use in magnesite stucco and cement mixtures (Sorel cement), and with one exception, was prepared from residual bitterns at salt plants in Alameda, Los Angeles, San Diego, and San Mateo counties. It was in part marketed in the liquid form. The exception consisted of a natural sulphate shipped from one of the desert dry lakes in Inyo County by the American Magnesium Company and refined at their plant at Wilmington. The sulphate marketed was utilized for medicinal and bath purposes.

With the use of magnesite cement and stucco coming more into prominence in building construction on the Pacific Coast, the demand for magnesium chloride is increasing here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

The average value reported for the chloride produced in California in 1924 was approximately $29 per ton, f. o. b. plant.

MINERAL PAINT.

Mineral paint materials were produced in California in 1923 from a total of three properties in Placer and Stanislaus counties, amounting to 532 tons valued at $5,234. This is a decrease from the 1049 tons and $11,773 of 1923. The material shipped from Placer County is hematite, and that from Stanislaus, yellow ochre.

ONYX and TRAVERTINE.

Onyx and travertine are known to exist in a number of places in California, but there has been only a small and irregular production since the year 1896. In 1924, a total of three operators in Mono and Solano counties shipped 24,350 cubic feet valued at $4,300 as compared with 14,220 cubic feet and $2,510 in 1923. The Solano County material is utilized mainly for terrazzo.

PLATINUM.

In California platinum is obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Calaveras, Sacramento, Stanislaus, and Yuba counties, with smaller amounts from the hydraulic and surface-sluicing mines of Del Norte, Humboldt, Shasta, Siskiyou, and Trinity.

The production of platinum-group metals in California for the year 1924 totaled 337 ounces, crude, containing 273 fine ounces, valued at $36,452. Of this amount, a total of 275 ounces, crude, or 82%, came from the gold dredges. This is less than 50% of the 602 fine ounces worth $78,546 sold in 1923, the decrease being due to cessation of dredging in Shasta and to a lessened output in Yuba County.

The above-noted total of 273 fine ounces includes 84 fine ounces of osmiridium and iridium, also some palladium. Most of the platinum refiners pay for the osmiridium on the basis of its iridium content. Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, and osmiridium or iridosmine, with occasionally some palladium. Iron, in amount from 5% to 15% is found alloyed naturally with most platinum as are also smaller amounts of palladium, rhodium, iridium, and osmium, also sometimes from 0.5% to 2% of copper. Osmiridium (iridosmine) sometimes also carries ruthenium in addition to the other members of the group above mentioned.

In addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the Mint, but which can not be assigned to the territory of its origin, for lack of knowing to which lots of gold it belongs. The San Francisco Mint has recovered as high as 100 ounces of platinum in a single year from this source, some of which unquestionably came from Californian mines. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

For 1924, the distribution by counties of California's platinum yield was as follows:

Platinum Production, by Counties, 1924.

County	Fine ounces	Value
Butte	(a)20	$2,829
Shasta	27	3,361
Trinity	11	1,839
Yuba	73	8,773
Calaveras, Del Norte, Humboldt, Mendocino, Sacramento,(a) Siskiyou, Stanislaus*	142	19,650
Totals	273	$36,452

(a)Includes palladium.
*Combined to conceal output of a single operator in each.

POTASH.

During 1924, a total of 33,107 tons of potash salts of all grades was produced in California valued at $747,407, compared with 29,597 tons and $709,836 in 1923. This included potassium chloride from salt-works bitterns and from Searles Lake brine, and sulphate from Portland-cement dust. The quality varied from 30% to 61.25% equivalent K_2O content, these salts being produced at plants in Alameda, San Bernardino, San Mateo, and Santa Cruz counties. The product sold was utilized mainly for the manufacture of fertilizers, and some for caustic potash (KOH).

PYRITES.

A total production of 124,214 short tons of pyrites, valued at $517,835, was reported shipped in California during 1924, from properties in Alameda, Mariposa and Shasta counties. This was a decrease both in tonnage and value from the figures of 148,004 tons and $555,308 in 1923. The material was mostly used in the manufacture of sulphuric acid for explosives and fertilizers, but a portion was utilized directly in the preparation of agricultural fertilizer and insecticide. The sulphur content ranged up to 46.9% S.

QUICKSILVER.

Quicksilver was produced in California in seven counties during 1924 to the amount of 7948 flasks valued at $543,080, being an increase of nearly 50% both in amount and value over the 1923 output of 5458 flasks and $332,851. The average price received during 1924, according to the producers' reports to the State Mining Bureau, was $68.33 per flask, as against $60.98 in 1923, and the record average of $114.03 for the year 1918.

The average of San Francisco quotations for 1924 was $68.69 per flask, the price varying from $59.35 in January, to $75 in April, declining to $69 early in December, but ending the year at $72.65. For the current year, 1925, quotations are ranging higher, the present figure (May 2) being $81.35.

The above-noted yield of 7948 flasks in 1924 was won from a total of 61,595 tons of ore, being an average content of 9.7 pounds per ton, or 0.485% mercury.

The increase in 1924 was due to greater output at the New Idria mine in San Benito County.

The U. S. Geological Survey reports the total production of the United States for 1924 at 9600 flasks (75 pounds, net), valued at

$659,424 (using the $68.69 average of quotations). Outside of California, the principal yield was from Texas, with a few flasks from Nevada, Oregon, Idaho, and Alaska. California's contribution was 82.5% of the total.

The 1923 quicksilver production in California was distributed by counties, as follows:

Quicksilver Production by Counties, 1924.

County	Flasks	Value
San Benito	4,670	$320,758
Sonoma	867	60,840
Lake, Monterey, Napa, Santa Clara, San Luis Obispo*	2,411	161,482
Totals	7,948	$543,080

*Combined to conceal output of a single operator in each.

SOAPSTONE and TALC.

The total output of talc and soapstone in California in 1924 amounted to 16,179 tons valued at $242,770, compared with 17,439 tons valued at $252,661 in 1923. More than three-fourths of the product was high-grade talc from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper, and rubber manufacture, and in part in magnesite stucco and flooring. The 'soapstone' grades were used mainly for roofing and as a filler in roofing paper, and part also in magnesite cement.

SODA.

The production of natural carbonates and sulphate of sodium in California in 1924 included soda ash and bicarbonate from plants at Owens Lake, Inyo County; trona ('sesqui-carbonate', a double salt of Na_2CO_3 and $NaHCO_3$) from Searles Lake, San Bernardino County; and salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County. The total amount to 32,536 tons, valued at $711,796, being a slight decrease both in tonnage and value from the 1923 figures of 34,885 tons and $764,284.

The dense ash and bicarbonate were used in the manufacture of soap, sal soda, glass, and chemicals; the salt cake in glass making; and the trona for neutralizing, in flotation concentration.

TUNGSTEN.

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920–1922 (inclusive), when the mines were shut down owing to low prices due to excess stocks following the war and to lack of tariff protection against foreign importations. Production was resumed on a small scale late in 1923. For 1924, a total of 705 tons of all grades, or 781 tons re-calculated to 60% WO_3 was shipped, valued at $446,009, being an increase over the 34 tons and $19,126 of 1923. The material shipped in 1924 included both high-grade sorted ore and concentrates, coming from properties in Inyo and San Bernardino counties.

Prices in 1924 varied around $9.00 to $10.00 per unit of WO_3 for high-grade scheelite. The present quotation (May 2, 1925) is $11.00 per unit.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors, as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

FRANK L. SANBORN, Mineral Technologist.

Bauxite has been reported from a number of different localities in California, but as yet only one authentic deposit is known, and this occurs in Sec. 26, T. 4 S., R. 6 W., S. B. M. in Riverside County. It is possible that there are undiscovered deposits of this valuable oxide of aluminum in the southern part of the state.

Bauxite resembles clay, but is usually distinguished at sight from clay by its pea-shaped, or pisolitic structure—a structure having small rounded concretions of the mineral imbedded in the mass.

A large deposit of bauxite in California would be commercially valuable for refractories and other purposes.

The demand is still good for pyrite and galena crystals suitable for radio crystal detectors. At the present time the price paid per ton for good pyrite crystals is probably about $2,000, and about $750 for galena.

The number of samples received and determined at the laboratory of the State Mining Bureau during the past three months has been 1119.

LIBRARY.

FOREST L. CAMPBELL, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

Bulletin No. 750-G—Bauxite in Northeastern Mississippi. By E. F. Burchard.
Bulletin No. 769—The Geologic Classification of the U. S. Geological Survey as Compared with Other Classifications. By M. G. Wilmarth.
Bulletin No. 761—Molybdenum Deposits. By Frank L. Hess.
Bulletin No. 760-B—The Physical Features of Cent. Massachusetts.
Bulletin No. 755—Mineral Resources of Alaska in 1922. By A. H. Brookes.
Bulletin No. 764—Phosphate Deposits in the Wind River Mountains near Lander, Wyoming. By D. D. Condit.
Bulletin No. 770—The Data of Geochemistry. By F. W. Clarke.

Mineral Resources of the United States:

Antimony in 1923.
Abrasive Materials in 1923.
Natural Gas in 1923.
Asbestos in 1923.
Natural Gas Gasoline in 1923.
Gold, Silver, Copper, Lead and Zinc in Nevada in 1923.
Gold, Silver, Copper, Lead and Zinc in Utah in 1923.
Gold, Silver, Copper, Lead and Zinc in California and Oregon in 1923.
Gold, Silver, Copper, Lead and Zinc in Montana in 1923.
Gold, Silver, Copper, Lead and Zinc in Arizona in 1923
Gold, Silver, Copper, Lead and Zinc in Washington and Idaho in 1923.
Iron Ore, Pig Iron and Steel in 1923.
Cement in 1923.

Water Supply Paper No. 538—The San Juan Canyon, Southeastern Utah.
Water Supply Paper No. 560-A—Water Power and Irrigation in the Madison River Basin, Montana.

- Water Supply Paper No. 520-E—The Artesian Water Supply of the Dakota Sandstone in North Dakota.
- Water Supply Paper No. 541—North Atlantic Slope Drainage Basins. By N. C. Drover.
- Water Supply Paper No. 519—Ground Water in Santa Clara Valley, California. By W. O. Clark.

U. S. Bureau of Mines:

- Technical Papers:
  - 322—Experiments in the Use of Back Pressures on Oil Wells.
  - 332—Conditions Affecting the Activity of Iron Oxides in Removing Hydrogen Sulphide from City Gas.
  - 337—Carbon Monoxide Hazards from House Heaters Burning Natural Gas.
  - 338—Smoke-Abatement Investigation at Grafton, W. Va.
  - 348—Gas Masks for Gasoline and Petroleum Vapors.
  - 351—The Electrical Manufacture of Carbon Black.
  - 352—Detection of Small Quantities of Petroleum Vapor.
  - 359—The Purification of Copper Sulphate Solutions.
  - 371—Coke Oven Accidents in the United States during 1923.
- Reports of Investigations:
  - Serial No. 2658—Pollution by Oil of the Coast Waters of the United States. By F. W. Lane, C. P. Bowie and J. S. Desmond.
  - Serial No. 2659—Explosives used in October, 1924. By W. W. Adams.
  - Serial No. 2660—Health Hazards in the Mining Industry. By R. R. Sayers.
  - Serial No. 2661—Exhaust Gases from Engines using Ethyl Gasoline. By R. R. Sayers, A. C. Fieldner, W. P. Yant, B. G. H. Thomas, and W. J. McConnell.
  - Serial No. 2663—Friction Factors for Metal Mine Airways. By G. E. McElroy and A. S. Richardson.
  - Serial No. 2664—Hazard of Unsafe Types of Gas Masks. By S. H. Katz.
  - Serial No. 2665—Explosives used in November, 1924. By W. W. Adams.
  - Serial No. 2666—Coal-Mine Fatalities in December, 1924. By W. W. Adams.
  - Serial No. 2667—Subject Index of Bureau of Mines Reports of Investigations Published during the Calendar Years 1919-1924. By G. E. Tufft and E. V. Brandenburg.
  - Serial No. 2668—A Test of CO_2 Recorders. By J. F. Barkley.
  - Serial No. 2672—Explosives used in December, 1924. By W. W. Adams.
  - Serial No. 2673—Coal-Mine Fatalities in January, 1925. By W. W. Adams.
  - Serial No. 2671—The Resistance of Coal-Mine Entries to the Flow of Air. By J. W. Paul, H. P. Greenwald and G. E. McElroy.
  - Serial No. 2669—Status of Research in Ore Dressing. By Earnest A. Hersam.
  - Serial No. 2670—Possibilities of Helium-Oxygen Mixtures for the Mitigation of Caisson Disease. By R. R. Sayers, W. P. Yant and J. H. Hillebrand.
  - Serial No. 2674—The Ignition of Firedamp by Exposed Filaments of Electric Mine-Lamp Bulbs. By R. D. Leitch, A. B. Hooker and W. P. Yant.
  - Serial No. 2675—Eleventh Semi-Annual Motor Gasoline Survey. By A. J. Kraemer and H. M. Thorne.
  - Serial No. 2676—Explosives Used in January, 1925. By W. W. Adams.
  - Serial No. 2677—Effect of Tank Colors on Evaporation Losses of Crude Oil. By Ludwig Schmidt.
  - Serial No. 2678—Some Common Mistakes in Operating a Stoker-Fired Boiler. By J. F. Barkley.
  - Serial No. 2679—Methods of Laboratory Grinding of Coke for Analysis. By W. A. Selvig.
  - Serial No. 2680—Coal-Mine Fatalities in February, 1925. By W. W. Adams.

California Department of Engineering:

- Bulletin No. 9—Water Resources of California.

California Department of Public Works:

- Report of the Division of Architecture, 1924.

Alabama, Geological Survey of:

- Bulletin No. 25—Statistics of the Mineral Production of Alabama for 1919 and 1920.
- Bulletin No. 26—Statistics of the Mineral Production of Alabama for 1921.
- Bulletin No. 27—Statistics of the Mineral Production of Alabama for 1922.

Georgia, Geological Survey of:

Bulletin No. 41—Iron Ore Deposits of Georgia. By R. H. Hazeltine.

Idaho Bureau of Mines and Geology:

Bulletin No. 6—Geology and Water Resources of the Goose Creek Basin, Cassia Co., Idaho.
Bulletin No. 8—Ground Water Supply of Moscow, Idaho.
Bulletin No. 9—Ground Water in Pahsimeroi Valley, Idaho.
Bulletin No. 10—Six Years' Work of the Idaho Bureau of Mines and Geology, 1919-1924.
Bulletin No. 11—Geology and Water Resources of the Bruneau River Basin, Owyhee Co., Idaho. By A. M. Piper.
Bulletin No. 12—Possibilities of Petroleum in Power and Oneida Counties, Idaho.

Illinois State Geological Survey:

Bulletin No. 45—Structural Reconnaissance of the Mississippi Valley Area from Old Monroe, Missouri, to Nauvoo, Illinois.
Report of Investigation No. 3—An Investigation of the Moulding Sand Resources of Illinois.

Missouri Bureau of Mines and Geology:

Biennial Report of the State Geologist for 1924.

Nevada:

Biennial Report of the State Inspector of Mines, 1923-1924.

North Carolina Geological and Economic Survey:

Biennial Report of the State Geologist and Director, 1921-1922.
Economic Paper No. 54—Water Power Investigation of Deep River. By Thorn Saville.
Circular No. 10—The Power Situation in North Carolina in 1924. By Thorn Saville.
Circular No. 11—Forest Fires and Taxation.
Economic Paper No. 55—The Mineral Industry of North Carolina from 1918 to 1923.
Biennial Report of the State Geologist, 1923-1924.

Oklahoma Geological Survey:

Circular No. 10—A Silurian-Devonian Oil Horizon in Southern Oklahoma. By G. D. Morgan.
Circular No. 11—Arkose of the Northern Arbuckle Area. By G. D. Morgan.
Circular No. 12—Stratigraphic Position of the Franks and Seminole Formations of Oklahoma. By G. D. Morgan.
Bulletin No. 32—Geology of the Southern Ouchita Mts. of Oklahoma. By C. W. Honess.
Bulletin No. 33—Geology of Love County. By F. M. Bullard.

Virginia Geological Survey:

Bulletin No. 25—The Valley Coal Fields of Virginia. By M. R. Campbell.

Washington Geological Survey:

Bulletin No. 31—Lead Deposits of Pend Orielle and Stevens Counties.

West Virginia Geological Survey:

Mineral and Grant Counties. By D. B. Reger.

The Parliament of the Commonwealth of Australia:

Petroleum Prospects of the Kimberly District of Western Australia and Northern Territory.

Department of Mines, South Australia:

Mining Review, No. 40.

Memorias de la Real Academia de Ciences y Artes de Barcelona:

Vol. XVIII:

No. 10—Las Nubes Cosmicas y las Irregularidades en el Perido de Ciertas Estrellas Variables.

No. 11—Representacion Grafica de Espacious Superiores.
No. 12—La Riquesa en Metales Preciosos de la la Espana Antigue.
No. 13—Odonatos Nuevos o Interesantes.
No. 14—Nota Petrograpfica Sobre Algunas Rocas de la Provincia de Tarragona.
No. 15—Consideraciones sobre un neuvo Renacimiento.
No. 16—Marquinas Electriceas a Velocidad Variable.

Department of Mines, Canada:

Investigations of Fuels and Fuel Testing.
Investigations of Mineral Resources and the Mining Industry.
Investigations of Ceramics and Road Materials.
Investigations in Ore Dressing and Metallurgy.

Dominion Fuel Board, Canada:

Coke as a Household Fuel in Central Canada.
The Smoky River Coal Feld. By James McEvoy.

Geological Survey of England:

Special Memoirs on the Mineral Resources of Great Britain, Vol. VIII.

Geological Survey of Great Britain:

The Geology of the Country Around Wem.

Instituto Geologico de Mexico:

Num. 10—Las Publicaciones del Instituto.
Num. 40—Catalogo Sistematico de Especies Minerales de Mexico.
Num. 40—El Cerro de Mercado Durango.

Department of Mines, New South Wales:

Bulletin No. 10—Silica. By L. F. Harper.
Bulletin No. 12—Coke. By L. F. Harper.
Bulletin No. 14—Asbestos. By R. G. Haggett.
Bulletin No. 15—Diatomite. By E. J. Kenny.
Bulletin No. 7—Gold.
Bulletin No. 8—Aluminum, Alunite, and Bauxite.
Bulletin No. 11—Cadmium and Mercury.
Mineral Resources No. 32—The Coal Resources of the Douglas Park Area.

Department of Mines, Ontario:

Thirty-third Annual Report of the Ontario Department of Mines.
Report of the Department of Mines for the Fiscal Year ending March 31, 1924.
Memoir No. 142—Preliminary Report on the Clay and Shale Deposits of Ontario.
Summary Report, 1923, Part B
Part C I
Part C II

Geological Survey, Scotland:

The Pre-Tertiary Geology of Mull, Loch Aline and Oban.

Societies and Educational Institutions.

University of California:

Vol. 15, No. 5—Notes on the Occurrence of Mammalian Remains in the Pleistocene of Mexico, with a Description of a New Species of Capromeryx Mexicana. By E. L. Furlong.

Colorado College:

Publication No. 129—Notes on the Life History and Feeding Habits of the Spadefoot Toad of the Western Plains. By R. J. Gilmoare.

Columbia University:

Summer Session and Announcement.

University of Missouri:

Briquetting of Zinc Ores. By B. M. O'Harra.

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. LXXVI.
Report of the U. S. National Museum for 1924.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Bulletin, Union Oil Co., Los Angeles.
California Journal of Development, San Francisco.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical Engineering and Mining Review, London, England.
Engineering and Mining Journal-Press, New York.
Explosives Engineer, Wilmington, Del.
Financial Insurance News, Los Angeles, California.
Graphite, Jersey City.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mine and Quarry, Chicago.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil and Gas News, Kansas City.
Oil News, Galesburg, Illinois.
Oildom, New York.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.

Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, Sacramento, Cal., and Unionville, Nev.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

* * *

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

31- 6 Mining Engineer; manager or mine foreman. Eighteen years' experience in South Africa. Age 40. Single. References. Salary wanted, $250.

31- 7 Mine Surveying. Four years' surveying experience. Age 33. Married. References. Salary wanted $150 and expenses.

31- 8 Shift Boss. Twenty-eight years' experience in Transvaal, South Africa. Age 44. References. Salary open.

31- 9 Mine Office Work. One year's experience as clerk and time-keeper. Age 23. Married. References. Salary wanted, $125.

31–10 Mining Engineer. Six and one-half years' experience as engineer, miner, leaser, and cyanide man. Age 37. Married. References. Salary wanted, $175.

31–11 Surveyor or outside foreman. Five years' experience as labor foreman and engineer. Age 42. Married. References. Salary open.

31–12 Mining or Oil Work. Russian Engineer. Speaks good English. Lots of experience in Russian mines, mills, and oil field geology.

31–13 Assistant Geologist. Three years' study at Minnesota and Iowa Universities. General and advanced geology, economic geology, mineralogy, paleontology, plane-tabling, surveying, and field trips. Age 24. Married. References. Salary wanted, $150.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; Pacific Finance Building, Los Angeles; in Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916, Fletcher Hamilton:	
Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	.65
Same, including geological map of Inyo County	1.25
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper	.50
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper	.50
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65
Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	3.75
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of State Mineralogist. Mining in California, Lloyd L. Root. Published quarterly. January, 1925	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, 1924	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps	$0.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations	.25
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted	2.50

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring, 1918. 248 pp., 51 illustrations, 5 maps, paper	$0.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California. (In preparation.)	------
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916–1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917–1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	.50
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	1.25
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth	1.00
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley, 1923	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley, 1924	Free

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	----

PRELIMINARY REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free
Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper	Free
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County	---

MAPS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County	----
Register of Oil Wells, with Map, Los Angeles City	----

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California, Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted	$0.50
**Unmounted	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	.25
**Map of Trinity County	----
Map of Tuolumne County	.25
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

Map No.	1—Sargent, Santa Clara County	.50
Map No.	2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No.	3—Santa Maria, including Casmalia and Lompoc	.75
Map No.	4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No.	5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No.	6—Salt Lake, Los Angeles County	.75
Map No.	7—Sunset and San Emido and Kern County	.75
Map No.	8—South Midway and Buena Vista Hills, Kern County	.75
Map No.	9—North Midway and McKittrick, Kern County	.75
Map No.	10—Belridge and McKittrick, Kern County	.75
Map No.	11—Lost Hills and North Belridge, Kern County	.75
Map No.	12—Devils Den, Kern County	.75

OIL FIELD MAPS—Continued.

	Price
Map No. 13—Kern River, Kern County	$0.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	1.00
Map No. 30—Rosecrans, Los Angeles County	1.00

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

o

39006 7-25 2750.

THE STATE MINING BUREAU

CORDIALLY INVITES YOU TO VISIT ITS VARIOUS DEPARTMENTS MAINTAINED FOR THE PURPOSE OF FURTHERING THE DEVELOPMENT OF THE

MINERAL RESOURCES OF CALIFORNIA

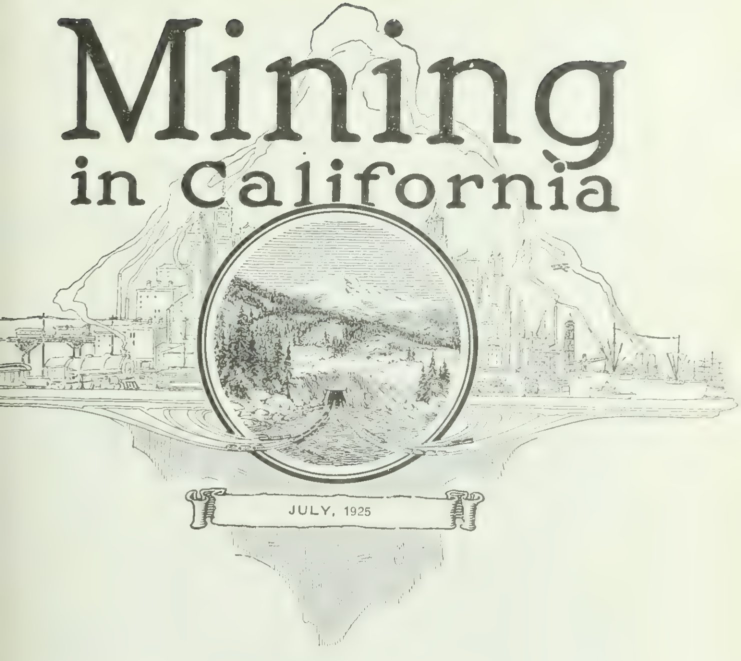
At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the State Mineralogist, as well as that of his technical staff, is also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily.
Saturday, 9 a.m. to 12 m.

LLOYD L. ROOT,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.
Branch Offices: Pacific Finance Building, Los Angeles; Chamber of Commerce Building, Sacramento, Bakersfield, Taft, Coalinga Santa Maria and Santa Paula.

Mining
in California



JULY, 1925

PUBLISHED QUARTERLY

CALIFORNIA STATE
MINING BUREAU
FERRY BUILDING
SAN FRANCISCO

CALIFORNIA STATE MINING BUREAU.

EXECUTIVE AND TECHNICAL STAFF

LLOYD L. ROOT
State Mineralogist

WALTER W. BRADLEY
Deputy State Mineralogist

MINING DIVISION

C. A. Logan, District Mining Engineer	Sacramento
C. McK. Laizure, District Mining Engineer	San Francisco
W. Burling Tucker, District Mining Engineer	Los Angeles
Frank Sanborn, Mineral Technologist	San Francisco
W. F. Dietrich, Ceramic Engineer	San Francisco

DEPARTMENT OF PETROLEUM AND GAS

R. D. Bush, State Oil and Gas Supervisor	San Francisco

Note.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT State Mineralogist

Vol. 21 JULY, 1925 No. 3

CHAPTER OF

REPORT XXI OF THE STATE MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1925

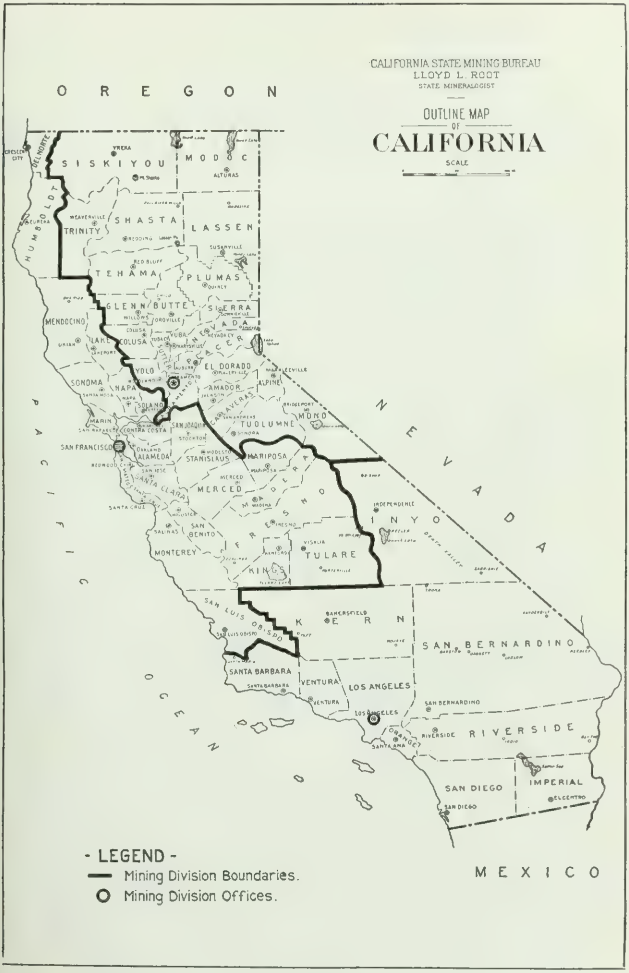
CONTENTS.

Page
DISTRICT REPORTS OF MINING ENGINEERS 275
- Sacramento Field Division 275
- San Francisco Field Division 281
- Los Angeles Field Division 325
- Oil Field Development Operations 383

SPECIAL ARTICLES 390
- Ore and Bullion Buyers' Licenses 390

ADMINISTRATION DIVISION 397
DIVISION OF MINERALS AND STATISTICS 398
- Statistics 398
- Museum 402
- Laboratory 403

LIBRARY 404
PRODUCERS AND CONSUMERS 410
EMPLOYMENT SERVICE 411
BUREAU PUBLICATIONS I


CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST

OUTLINE MAP
OF
CALIFORNIA

PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

Ancient Channels of the Duncan Canyon Region, Placer County.

The accompanying map is the first one ever prepared showing in detail the claim boundaries, topography, location of placer mining workings, and approximate location of buried ancient channels in the region of Duncan Canyon, Placer County. The area mapped extends from Duncan Peak (elevation 7177 feet) southwest to near the mouth of Duncan Canyon, which empties into the Middle Fork of American River just south of the map, and is in the eastern part of the county being accessible during the dry season by automobile from Colfax and Auburn via Forest Hill. The various claims are from 54 to 58 miles from Auburn. They lie at elevations of from 4200 to 5000 feet, and are isolated in winter because of heavy snowfall. The old placer mining camp of Last Chance lies a few miles west, and mail and light supplies come in that way by pack trail from Michigan Bluff.

Topography and Geology.

The area mapped is a well timbered mountain ridge sloping gently southwest but pitching off abruptly into Duncan Canyon on the east. This ridge is for the most part covered by a thick mantle of andesite mud flows with bedrock exposed at Millers Defeat and on the lower slopes of the canyon. The bedrock series here includes the older carboniferous rocks, principally clay slates, quartzite and quartzitic sandstone, chert and hard siliceous schists, locally grouped as the Blue Canyon formation. No gold quartz mines have been worked at depth here, but considerable rich float has been found on the west side of the canyon. At the Barney Kavanaugh diggings in the east half of Sec. 21, T. 15 N., R. 13 E. gold occurs in quartz stringers and seams in the sandstone and clay slate bedrock and has been profitably hydraulicked. Millers Defeat Canyon has also been hydraulicked. On the Duncan Canyon side in early days all the larger canyons and ravines supported many placer miners, principally Greeks, of whom the only remaining records are a few local landmarks and names. It seems probable that these ravines derived their coarse gold from the erosion of older channels and morainal deposits on the west side of Duncan Canyon and that most of the gold came originally from bedrock erosion nearby. Fragments of such older deposits have been hydraulicked at a number of places and enough has been done to prove the existence of a system of channels. These channels show gravel and sub-angular rock derived from the more resistant members of the country bedrock, and carry little quartz. Such a channel as that in the Jack Robison claim corresponds to the intervolcanic system of the lower mountains; the gulch channels, such as in the Glenn Mine, are undoubtedly earlier. No strictly primary channel was noted here, although there is such a channel in the Carmack Mine at Canada Hill, at a higher elevation.

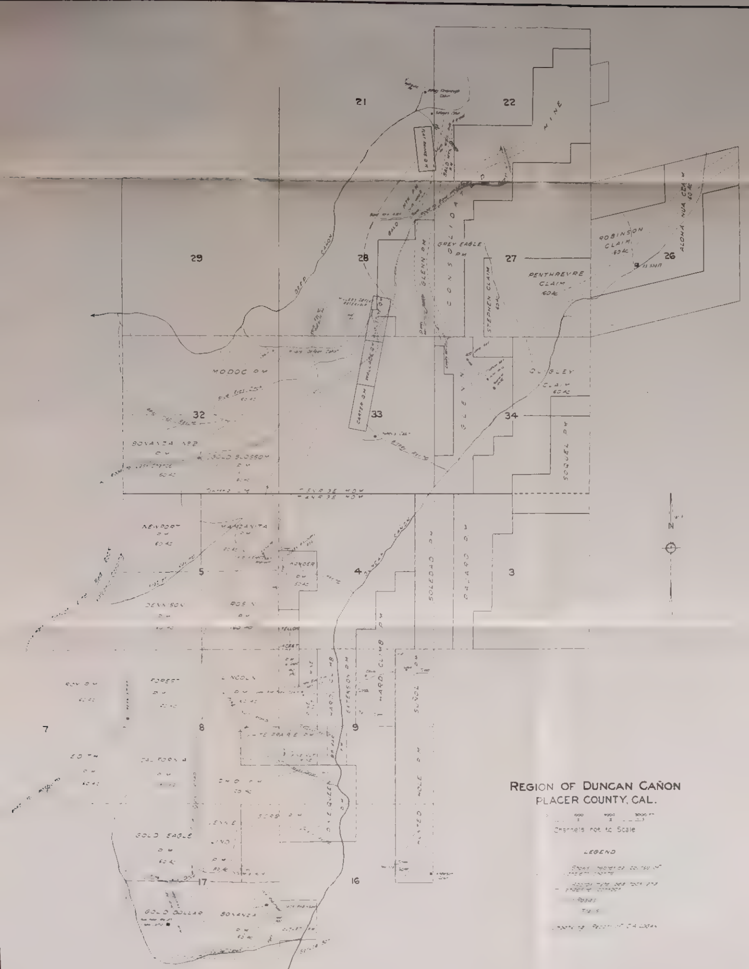
Acknowledgment.

The area has not been covered by the public land survey and the writer is indebted to the late E. A. Hill and J. B. Warner and to J. A. Shields, county surveyor, from whose private surveys most of the details of claim boundaries, section lines and bedrock contacts have been compiled.

Gold was mined here first in the '50's, but the area remains a baffling puzzle to the drift miner, with an early day record of very rich surface placers, but with a small production in later years from the deeper ground, and with miles in length of unexplored channels, some of which may be traced to the center of the mountain range.

Mining development is summarized below. The courses of the ancient channels are problematical, except where proven, because of the heavy and widespread andesite cover and scarcity of bedrock rim exposures.

Bald Mountain Mine. F. C. Vinzke, Westville. In Secs. 21, 22, 28, T. 15 N., R. 13 E., 160 acres. The old adit, 800 feet long with a short



REGION OF DUNCAN CAÑON
PLACER COUNTY, CAL.

Channels not to Scale

incline and 1000 feet of drifting northeast upstream, failed to bottom the channel and followed the west rim. This is in the northeast quarter of Sec. 28. In the southwest quarter of Sec. 22 a shaft 100 feet deep with some drifting along the channel was in pay gravel, but is caved. A new adit was begun 300 feet lower than the 800 foot adit on the Deep Canyon side, but has not been completed to the channel. This channel is the upstream continuation of the Glenn channel. Idle for years.

Blue Eyes Prospect. S. S. Caples and Mrs. Emma Caples, 3634 Sixth Avenue, Sacramento, owners. Gold Dollar Mining Company, lessee, with option to purchase. Comprises Modoc, Bonanza No. 2, Gold Blossom, Newport, Manzanita, Dennison, Robin, Yellow Jacket, Wonder, Roy, Forest, Edith, California, Ohio, Gold Eagle, Jennie Lind, Gold Dollar, Bonanza and Jack Robison placer claims, containing in all about 2580 acres, extending from Deep Canyon to Spruce Canyon.

The earliest work was done in the '50's by A. Houck. An hydraulic pit was opened on the Wonder claim and another farther south on the Yellow Jacket. These were on a steep channel which flowed south from Millers Defeat and the top portion of which was worked in the intervening modern gulches but has never been bottomed, as far as can be learned. The New Blue Eyes adit was run 500 feet north of west from the southeast corner of Yellow Jacket claim toward the channel but has not yet reached it. On the adjoining Pine Nut Mine this channel shows angular unassorted gulch wash. It has probably been cut off by the later and deeper channel running southwest from the Dixie Queen Mine.

On the southeast quarter of Gold Dollar claim a tunnel was started a few years ago and has been run 2300 feet northwest. Some promising gravel was found in a winze near the portal, but no channel has been bottomed and most of the adit is in the andesite. Attention has lately been turned to the old Jack Robison adit which was started in a good sized channel carrying coarse boulders. This adit was too high at the start and although it has now been run 900 feet it has not yet bottomed the channel. This channel has probably swung around in a wide curve from the Dixie Queen Mine, cutting off all the smaller and richer gulch channels in its path. Possibly of generally low gold content itself, it is no doubt enriched wherever it has cut other channels and may prove worth following in search of these crossings. The elevation at the portal of Jack Robison adit (not on bedrock) is 4550 feet (aneroid), and the portal of the Gold Dollar adit is 50 feet higher. The property is equipped with good camp buildings and has a private road to within one-fourth mile of the camp.

Dixie Queen Mine. J. Scherer, A. Morehead and J. Franks, owners. Contains Gore and Dixie Queen claims, 240 acres. Work has been done on Dixie Queen claim. An adit has been run 800 feet nearly south and an area about 200 feet long and 55 feet wide 15 feet above the adit has been breasted, yielding about $7,000. The tunnel is now partly caved and little has been done the past few years. A width of 60 feet to 87 feet of gravel has been opened and probably three-fourths mile of channel remains unworked. This channel runs nearly south and is generally supposed to be the same as in the Hard Climb and

Jack Robison. The elevation on bedrock at the Dixie Queen is 4625 (aneroid) which would indicate a very steep grade from the Hard Climb, unless there has been faulting along Duncan Canyon.. Water is taken from Abrams Canyon, 25 to 30 inches being available 10 months of the year. There is a dwelling on the claim, which is reached by trail from the Pine Nut Mine.

Glenn Consolidated Mine extends through Secs. 22, 27, 28 and 34, T. 15 N., R. 13 E., as shown. Owner, Glenn Consolidated Mining Company, George McAulay, A. K. Robinson et al., Auburn. Leased to Tillotson Mining Company, F. Tillotson, superintendent. As described in our Preliminary Report No. 8, January, 1922, this mine has been the only producer in the district lately. With the exception that the lowest adit has been extended, and work has been continued in the upper Shields tunnel with a substantial gold production from both, the extracts following from the above report sufficiently describe the property.

"The lowest and last tunnel is one driven by the present company and starts 600 feet north of the south line of the Outlet claim. It struck pay gravel almost directly below the portal of the Moss tunnel. Up to the time of visit this lower tunnel was 620 feet long and had followed the channel in pay for 150 feet. The gravel had been worked 12 to 15 feet wide. The gravel is mostly hard schist boulders with little quartz in it. It ranges from nothing to 2½ feet in thickness, being overlain by a coarse volcanic sand which in places closes directly down upon the hard polished schist bedrock. The gold is mostly in the crevices of the bedrock. The thinness or absence of the gravel and the coarseness and location of the gold are due to the steep grade of the old stream. This is plainly shown in the upper workings.

"The upper workings consist of the Quigley tunnel, largely on the west rim, and about 1600 feet long and too high; and the Shields tunnel, which is 1800 feet long including a fork to the right. The portal of the Shields tunnel is 2350 feet north of the portal of the Tillotson tunnel, measured along the channel. The Shields portal is at an elevation of 5345 feet, which is 382 feet above the Tillotson portal. The face of the workings on the left fork of Shields tunnel is 140 feet higher than the portal, showing this steep rise in a distance of 1500 feet, along which there are many sheer drops of several feet, evidently waterfalls in the old channel, and not faults. The Moss crevice, 950 feet in on the Shields tunnel, was 22 feet by 55 feet, and is said to have paid $9,000. Beginning 735 feet in this tunnel, pay gravel had been breasted for a length of 200 feet and up to 35 feet wide, to the time of visit, July 30, 1921. This breast was said to have yielded about $10,000 then. The lower workings have since continued in good pay."

The Glenn channel extends on the north into the Bald Mountain property, and has been proven at intervals for a mile and a half.

Hard Climb Prospect. Owners, McCullough Brothers, of Michigan Bar, and Charles Hilton. Reached by trail from the Glenn Mine or Pine Nut Mine. A bedrock adit 213 feet long running N. 35° E. with crosscuts 45 feet west and 60 feet east showed gravel of low grade the entire width. Another adit 155 feet long struck gravel 50 feet from the portal. A third or north tunnel is 210 feet long and too high. The channel courses S. 37° W., the direction of flow being shown plainly by shingling of the gravel. A shaft 45 feet deep has been sunk on the west rim of the channel at a point 1000 feet north of the north tunnel. The aneroid reading at the portal of the bedrock adit was 4760 feet. According to H. W. McCullough, $15,000 has been spent in developing the property, and some of the gravel ran as high as $4 a ton, the richest being higher than that. The channel is about 300 feet wide and carries little quartz.

There is about 2500 feet of ditch but only a small amount of water available. There is a dwelling on the property.

Park and Brown. (Barney Kavanaugh diggings.) C. D. McKinley, Auburn, and A. Harmeson. This hydraulic mine contains 160 acres in the east half of Sec. 21, T. 15 N., R. 13 E., has been idle except for assessment work for several years. The deposit consists of the upper decomposed portion, 3 feet to 6 feet deep, of a stockwork of quartz, stringers carrying gold in iron stained shale and sandstone. It covers a side hill area 400 feet by 1500 feet and the larger part has been piped off. The water for working was brought from Deep Canyon and the piping season was only about six weeks.

Bibl: State Mineralogist's Report XV, p. 377.

Pine Nut Mine. Owners, F. C. Davidson and Joseph Scherer, address via Michigan Bluff. It contains the Lincoln and White Prairie placer claims, 320 acres. The camp buildings were destroyed by a forest fire in 1924.

About an acre was hydraulicked 24 years ago. Elevation of bedrock 4930 feet (aneroid). The channel has a total width of 600 feet and a bank 80 feet high. It has a steep grade said to be 6% and can be traced to near Millers Defeat. It courses south and is believed to traverse this property for one-half mile. It is partly rough, subangular wash with some large boulders, and ground washed is said to have averaged 20 cents to 27 cents a yard. A tunnel on the west side of pit was 40 to 50 feet above bedrock. There is a ditch about 2 miles long with a capacity of 1200 miners inches of water from Spruce Canyon, and 1000 feet of pipe. There is a damsite nearby below the mine.

Robinson Prospect contains the Quigley, Stephen, Penthrevre, Robinson and Aloha Nua placer locations, 700 acres in all, in Secs. 26, 27 and 34, T. 15 N., R. 13 E. Owner, A. K. Robinson, Auburn. The claims are on a large channel which enters the mapped area from the northeast, parallel and close to the present course of Duncan Canyon. The only work has been for assessment purposes. A shaft 35 feet deep was sunk on the bank of Duncan Canyon near the French Meadows trail, but did not bottom the channel, which is here lower than the stream. Due to the channel being below the present drainage, the only place it can be reached by a drainage adit is the extreme south end of Quigley claim or possibly on the adjoining part of the Glenn Mine. This channel is locally known as the Chalk Bluff channel and is commonly believed to be the same one that traverses the Hard Climb, Dixie Queen and Jack Robison ground, although it will be seen that there is a distance of about two miles on the map between the proven sections. Aneroid readings in such a canyon are far from reliable, and as has been shown in the case of the Glenn channel, there are such sudden changes in grade that no sure conclusions can be derived from a comparison of elevations, except in cases of large variations

Red Star Prospect. (Formerly included Hunted Hole, Sunol, Soledad, Pajaro, Soquel and other claims, but more recently only Hunted Hole placer claim.) The owners are D. M. Ray, of Last Chance, and M. Savage.

There are four adits on this prospect, but part are caved. The lowest is 40 feet long, showing gravel with some large granite boulders. The elevation (aneroid) is 4500 feet. About 600 feet east and 280 feet higher, is another adit, where the workings are caved 95 feet in. A third or north adit, at an elevation of 4790 feet (aneroid) forks ten sets from the portal, one branch running north 130 feet, another northeast 145 feet. In the north branch, the bedrock rises on the east and dips west on the west side. In the northeast branch the adit passes through high bedrock but near the face comes into a channel of well washed, fairly clean gravel containing a little quartz. This work was stopped in gravel. The work indicates either two channels at their junction, or a high reef of bedrock in mid-channel. About 100 feet east of and 10 feet higher than this adit, another was driven 100 feet in gravel well above bedrock. These adits are not shown on the map.

The prospecting of the property indicated gravel of a tenor too low grade to pay steadily, although rich in spots. The aneroid readings indicate such wide differences of elevation between these workings and those west of Duncan Canyon, as to show they are on different channels. One of the Red Star channels is probably an ancient course of the Middle Fork of American River.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

DEL NORTE COUNTY.

Introduction.

The territory within the present boundaries of Del Norte County was originally (1850–51) a part of Trinity County,[1] which at that time included all the drainage basin of the Klamath River and its tributaries. In 1851 the northern half of this large area was organized as Klamath County. A part of this county was included in Siskiyou when the latter was formed in 1852. Changes were made in Trinity County's boundaries in 1855, which reduced the area of Klamath County, but it still lacked unity. The seat of county government was successively located at Trinidad, Crescent City and Orleans Bar.

This final move resulted in division and the organization of Del Norte County on March 2, 1857, with Crescent City as the county seat. Its area was considerably larger than at present, and the eastern boundary was changed three times in the next 30 years; it being moved westward to its present position in 1887.

Klamath County continued to exist until 1875, when its dissolution took effect, part being added to Siskiyou and part to Humboldt.

Geography.

Del Norte County occupies the extreme northwest corner of the state. It contains 1024 square miles and its population is 2759 (1920 census). The county is noted for its excellent stands of timber, particularly its redwood forests, and this covering somewhat softens the outline of its otherwise almost Alpine ruggedness. Over most of it a dense growth of vegetation so covers formations that prospecting is difficult, and in new country trails must be cut before it can be explored.

The county boundaries coincide closely with the natural drainage basin of Smith River, and this stream and its various branches drain most of the area. A few creeks which head in the southern part flow south and unite with the Klamath River.

The 'Redwood Highway,' extending up the coast through Humboldt County to Crescent City and thence to Grants Pass, Oregon, is being re-routed and reconstructed so that travelers may now pass through the county with ease. However except for a few main roads, there are only trails penetrating much of the interior.

Del Norte County has no rail connection with the outside. Lumber schooners and light draft vessels dock at Crescent City, and the county is dependent upon these, auto stages, trucks, wagon and pack trains for transportation. The difficulties encountered are well illustrated in the case of a shipment of copper ore from a property in the Low Divide district to the Tacoma smelter. After trucking over a mountain road to Crescent City and a long delay there at the dock, it was finally taken by schooner to San Francisco and then reloaded onto a larger boat for delivery at Tacoma.

---

[1] Coy, Owen C., California County Boundaries, California Historical Survey Commission, Berkeley, 1923.

Geology.

A low coastal plain, three to five miles in width, extends from the vicinity of Smith River to a point a few miles south of Crescent City. East of and surrounding this area of Quaternary formations and extending from the Oregon line through Del Norte and south into Humboldt is a belt of Franciscan rocks, mainly sandstones and shales. The eastern boundary of this belt crosses Smith River just west of South Fork, and its contact with the succeeding zone of metamorphic and eruptive rocks marks the line between the Coast Range and the Klamath Mountains. This succeeding zone of metamorphics also extends through the county from north to south, widening out toward the north, where its width is about 15 miles. It is composed mainly of serpentine with unaltered masses of peridotite and many inclusions of 'diorite,' more or less altered. This belt is mineralized and most of the deposits of gold, copper, chromite, and platinum are associated with it. Between here and the eastern boundary there is another narrow belt made up largely of Franciscan schist and slate, intruded by deep-seated igneous and volcanic rocks. Serpentine again predominates along the boundary and extends over into western Siskiyou County.

Mineral Resources.

It may be argued that Del Norte is not a 'mining county,' yet mining was probably the first established occupation, and Trinidad and Crescent City were at one time important distributing points for miners' supplies. Rich placer diggings were worked in the early days but no record of their output is preserved. Copper mining was active in the sixties.

Lumbering is at present the principal industry. The county's timber resources may be readily and accurately measured, but its mineral resources are less easily gauged. No large 'deep' mines have been developed, but the isolated position and inaccessibility of the county have been a severe handicap to operations requiring heavy machinery and equipment. From a mining standpoint, the county is still largely unprospected and practically undeveloped. To the small operator or man who wishes to combine mining with other means of earning a livelihood, it offers excellent opportunities. Most of the placer mines are held by early settlers and are thus occasionally worked, as conditions warrant. On account of its sparse settlement and lack of aggressive mining methods, compliance with the mining laws in the matter of locating and doing annual labor has been lax. An examination of the recorded notices of location shows in many cases that these do not meet the legal requirement that they contain "such a description of the claim by reference to some natural object, or permanent monument, as will identify the claim located." New highways are rapidly opening up this northwest section of the state, which includes Del Norte, western Siskiyou, Trinity, and Humboldt counties. It is being invaded in increasing numbers by mining men, and, unless claim owners, who have for many years been in undisturbed possession, guard their rights by careful observance of the mining laws, disputes and conflicts over possession may arise.

The chief mineral resources of Del Norte County are chromite, copper, gems, gold, iron, the platinum group metals, silver, and miscellaneous stone. Arsenopyrite, cinnabar, graphite, molybdite, monazite, asbestos, zircon, and a half dozen other minerals are also found here. Of special interest to mineralogists, in addition to a possible commercial value, is the occurrence of troilite[1] near Crescent City. Troilite is a simple sulphide of iron, FeS. Artificially produced, it is used for technical purposes. The natural mineral has been previously identified only in meteorites.

The last general report on the mines and mineral resources of Del Norte County appeared in Report XIV of the State Mineralogist, 1913–14. The chromite deposits are described in Bulletin No. 76, 'Manganese and Chromium in California,' 1918. Occurrences of the platinum metals are discussed in detail in Bulletin No. 85, 'Platinum and Allied Metals in California,' 1918 (out of print). They are also mentioned in connection with placer gold deposits in Bulletin No. 92, 'Gold Placers of California,' 1923.

The writer spent ten days in the county in June, 1925, in an endeavor to bring data that had appeared in earlier reports up to date, and in gathering notes on new developments. In order that this report will be as complete as possible, some descriptive matter from earlier publications has been included, especially in the case of properties idle at the time of visit. During the decade between the publication of Report XIV and the present report undoubtedly some operations were started and discontinued, of which it is now impossible to obtain authentic information.

The assistance of members of Crescent City and Del Norte County Chambers of Commerce, as well as the courtesy of mine owners and operators, is gratefully acknowledged.

The total recorded output and value of the mineral production of the county from 1880 to 1924, inclusive, is given in the accompanying table.

---

[1] Eakle, A. S., Minerals of California: Cal. State Min. Bur., Bull. 91, p. 48, 1923.

DEL NORTE COUNTY, 1880-1924.

Year	Gold, value	Silver, value	Platinum		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
			Ounces	Value		Amount	Value	Substance
1880	$215,403	$300						[2]
1881	60,000							
1882	80,000							
1883	135,000							
1884	100,000							
1885	39,390	9						
1886	76,189							
1887								
1888								
1889	21,800							
1890	900							
1891	5,586							
1892	4,102							
1893	10,352							
1894	8,000							
1895	8,250							
1896	24,150							
1897	16,710							
1898	9,057							
1899	4,450							
1900	3,483							
1901	10,612							
1902	5,450							
1903	7,183							
1904	7,399		1.5	$18				
1905	10,590		1.5	22				
1906	5,945	33						
1907	878	3						
1908	3,488	19				74,787 lbs.	$9,984	Copper.
1909	1,610	52				24,449 lbs.	13,085 20,000	Copper. Unapportioned, 1900-09
1910	2,388	62				26,670 lbs.	3,395	Copper.
1911	1,743	7						
1912	3,940	10						
1913	2,498	16						
1914	2,035	9	14	643	$3,250			
1915	1,018	6			3,500			
1916	405	2	2	73	1,685		267	Chromite and copper.
1917	1,373	8	10	853	2,700	3,275 tons	97,255 2,151	Chromite. Other minerals.
1918	565	4	1	97	8,000	7,143 tons	360,485 2,584	Chromite. Other minerals.
1919	867	6			6,300		67	Other minerals.
1920					9,000		2,781	Chromite and copper.
1921	[3]	[3]	[3]		5,580		449	Gold, platinum, silver.
1922	[3]	[3]	[3]		5,500		761	Gold, platinum, silver.
1923	1,778	9	[3]		31,368		872	Copper and platinum.
1924	325		[3]		721,720		220	Unapportioned.
Totals	[3]$895,002	[3]$555	[3]30	$1,706	$798,603		$511,356	

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.

[2] Gold, copper and chromite were produced in Del Norte County earlier than the years shown, but the amounts are separable by counties.

[3] See under 'Unapportioned.'

Among the fifty-eight counties of the state Del Norte ranked 26th in the value of its mineral output in 1924.

BLACK SAND.

Investigations of the black sand deposits of the Pacific Coast, including those in Del Norte County, have been carried on at intervals by the U. S. Geological Survey,[1] the U. S. Bureau of Mines,[2] the State Mining Bureau and other agencies and much has been written concerning them. They also have been the subject of hundreds of attempts on the part of individuals and companies to exploit them for their gold and platinum content.

---

[1] Day, David T., and Richards, R. H., Useful Minerals in the Black Sands of the Pacific Slope, U. S. Geol. Survey, Mineral Resources of the United States, 1905.

[2] Horner, R. R., Notes on the Black Sand Deposits of Southern Oregon and Northern California, U. S. Bureau of Mines, Technical Paper 196.

The gold-bearing gravels of Smith River basin contain black sand, which usually contains some platinum values and a small annual recovery of platinum metals is common in cleaning up. The beach sands of Del Norte County also carry values in finely comminuted gold and platinum, but although the latter metal has commanded a very high price during and since the World War, no method yet has been developed for working them which has proved commercially successful on anything larger than a hand scale. Probably the simplest type of machine used on beach sands is one described by Haley.[1] It consists of a plain duck broad riffle, fastened to a plank bottom, which is set out near the edge of the sea as the tide is coming in, and is kept constantly in such a postion that the outgoing waves would wash the gold-bearing black sands over it. This machine has been used near Crescent City, and has paid day wages to the men operating it.

The beach two miles south of Crescent City was also the site of one of the most elaborate plants ever erected for working the sands on a large scale. This plant was erected in 1913 by the Oro Del Norte Company, who owned 255 acres along the beach. It was designed to handle 800 yards of sand per 24 hours and cost $125,000. Metallurgically and financially, however, it proved a total failure, and only a few ruins still standing upon the beach now mark the location.

The beach near Crescent City has been a favorite place for trying out black-sand machines and processes, but operations are usually short-lived. At the time of visit no beach mining operations were being attempted in the county.

Bibl: State Mineralogist's Report XIV, pp. 375–379; State Min. Bur. Bull. 45, Bull. 85, Bull. 92; U. S. Geol. Survey Bull. 260, Bull. 285, Bull. 315; Min. Res. 1905; Geologic Folios 89, 73; U. S. Bureau of Mines Tech. Paper 196.

COAL.

Some thin layers of lignite occur in the underlying formations of the low coastal plain in the vicinity of Crescent City. A vein of tough brown lignite, four feet in thickness, is said to have been pentrated by two bore-holes three quarters of a mile apart and 160 feet deep, located about 400 yards inland, opposite Point St. George. These borings were made in 1885. No further development work has ever been done.

Bibl: State Mineralogist's Reports, XI, p. 198; XII, p. 50; XIII, p. 52; XIV, pp. 373, 380; XVIII, p. 155.

CHROMITE.

The known chrome ore resources of Del Norte County are extensive, and in addition there is much territory throughout the areas of serpentine and associated rocks traversing the county that holds promise of further discoveries if thoroughly prospected.

In common with practically all of the chrome mines of the state, operations in Del Norte County ceased abruptly with the collapse of the chrome market in 1918, and the mines have since remained idle.

---

[1] Haley, Chas. S., Gold Placers of California, State Mining Bur. Bull. No. 92, p. 69.

So far as development has shown, the ores here appear to occur typically in lenses, some of which are of large size with well-defined walls. It is the massive black chromite, the chromic oxide content varying from 40% to 50%. This black ore contains very little silica.

The chrome mines and prospects were described in detail in our Bulletin No. 72, 'Manganese and Chromium in California,' 1918, and, as there has been practically no changes since its publication, they will be only briefly mentioned herein.

Copper Creek or Low Divide Mine. Property consists of four claims in Sec. 35, T. 18 N., R. 1 E., in the Low Divide district, owned by the Tyson Estate, Baltimore, Md. A good-sized deposit was opened up here and considerable production was made before the decline in price caused the mine to be shut down.

French Hill Chrome Mine. Property is in Secs. 5 and 6, T. 16 N., R. 2 E., on the north slope of French Hill. A considerable output of high-grade chromite came from this property which is also owned by the Tyson Estate, Baltimore Md. Both the Copper Creek and French Hill mines were under lease to R. D. Adams and C. S. Maltby, Humboldt Bank Building, San Francisco, during their period of activity.

Friday Prospect. Located in the High Plateau district in Secs. 21 and 28, T. 18 N., R. 2 E. A 6-foot outcrop showed on this property which was owned by John Hester and H. H. Morrell, of Crescent City.

Hawkins Deposit. Property lies one mile west of the Friday prospect, in Sec. 21, T. 18 N., R. 2 E. An outcrop of good chromite, with a maximum width of 30 feet, was exposed here. A sample is said to have shown 56% Cr_2O_3. This deposit is probably one of the best in the county, and large expenditures were made in constructing a road to connect it with the Crescent City-Grants Pass road, at a point north of the Oregon line. One hundred sixty men are said to have been engaged at one time on road construction. Special narrow-gauge trucks were constructed to transport the ore. Owned by S. J. Hawkins, of Crescent City.

High Plateau Group. Consists of four claims in the south half of Sec. 30, T. 18 N., R. 2 E. Lenses of ore 10 feet and 8 feet wide were exposed for over 100 feet in length. Owned by H. H. Morrell and John Hester, of Crescent City.

Owl Claim. This property adjoins the French Hill Mine. An orebody 7 feet in width was exposed on the claims. Owned by Silas White et al., Crescent City.

Numerous other claims were located during the emergency caused by the World War, particularly in the vicinity of Gordon Mountain ten miles east of French Hill, and in the Rattlesnake Mountains. Between French Hill and Upper Coon Mountain, on the east, and Madrona, on the south, other locations were made during the summer of 1917. These locations are accessible by trail only and are undeveloped.

Bibl: State Mineralogist's Reports, X, p. 167; XII, p. 36; XIII, p. 48; XIV, p. 380. State Min. Bur. Bull. 38, p. 268; Bull. 76, pp. 124–131; Bull. 91, p. 109.

CLAY.

The local demand for brick and tile is so small that there has been practically no development of a clay industry, although a small brick plant was at one time operated in Elk Valley. Common brick clay is said to be abundant in Elk Valley, and possibly some deposits may be suitable for pottery use. No special investigation of the clay deposits has ever been made, and at the present time this mineral resource is not being utilized.

Bibl: State Mineralogist's Report XIV, p. 379; State Min. Bur. Prel. Report No. 7, p. 46.

COPPER.

Copper holds an important place among the mineral resources of Del Norte County, and it is interesting to note that the mines in this county were prominently identified with the beginning of the copper mining industry in California. Copper mining was actve here in the sixties, and thousands of tons of high-grade ore were shipped to European smelters.

Occurrences of copper minerals are widespread. The ore is often very high grade, consisting of copper glance, black and red oxides, carbonates and native copper. Chalcopyrite is found in minor amount. Gold and silver values almost always accompany the copper. Most of the deposits are found in the serpentine areas or associated with them and are in the form of irregular veins, lenses and bunches. Diorite dikes are common, and where these occur the ore is considered more persistent.

So far as development has shown, the principal districts are Low Divide and Diamond Creek, in the northern part, and the Dr. Rock district, in the southeastern part of the county. Prospects have also been noted in the Monumental district, at French Hill and in other scattered localities.

Alta California Mine. A detailed description of this property and map of the working is contained in Report XIV of the State Mineralogist. Between the years 1860 and 1870 the mine was operated through an incline shaft 455 feet deep, having an inclination 63° E. A total of 895 feet of drifting had been done on the four levels. The ore was shipped to Swansea, Wales, and to Germany. From old records it is shown that ore carrying 15% to 18% copper was mined and 11% ore was being taken out at the time the mine was closed down. Records of shipments sent to Swansea give returns of $41 to $102 per ton. The mine has been idle for many years, and all equipment has been removed. Owned by the Alta California Mining Co., 519 California Street, San Francisco. It was bonded for a time to the Salt Lake-California Copper Co., of Salt Lake City, Utah.

Doctor Rock Group. This property includes six claims situated in T. 13 N., R. 3 E., H. M., at the head of Blue Creek. The claims have an elevation of 4475 feet. A 15-mile trail is the only means of reaching them. The ore is quartz, carrying chalcopyrite and other copper sulphides, with gold and silver values. Assays showing 40% copper, $3 in silver and $5 in gold are reported. Assessment work is kept up. The mine is offered for sale for $10,000 by the owner, Martha Thompson, Orick.

Frank Zaar Copper Mine. Property consists of four claims on Copper Hill, owned by Frank Zaar, of Smith River. There is a prominent gossan on the claims, and several veins from four feet to six feet in width, carrying gold-silver values and up to 10% copper, have been cut in doing development and assessment work. There is over 1500 feet of tunnel work and several shafts. Assessment work is being kept up by the owner.

Hunters Luck Claims. This group has been help by location since 1907. There are six claims, located in T. 18 N., R. 3 E., at an elevation of 3100 feet. Malachite, bornite, and chalcopyrite occur in a vein striking north and dipping 50° E. Assessment work and some development are being done by the owners, J. W. Ehrman and J. W. Britten.

Occidental Group. Property consists of four claims in the Low Divide district, lying south of and adjoining the Alta California. Owners are McBride, Musgrove and Carson. Workings consist of a 450-foot tunnel, which has not yet reached the vein, a 110-foot shaft, which shows two feet of ore, and another shaft 100 feet in depth. Surface ore on this property shows a high copper content running from 30% to 32%. Assessment work is being done.

Oriental Copper Claim. One claim, formerly owned by E. R. Jenkins, of Crescent City, but now included in the Frank Zaar Copper Mine holdings. Some high-grade ore was exposed on this claim.

Salt Lake-California Mine. Originally known as the Union Copper Mine, this property, which adjoins the Alta California Mine, was formerly owned by the Salt-Lake-California Copper Co., of Salt Lake City, Utah. The latter company has gone out of existence, and the mine, again renamed the Union Copper Group, is now owned by Frank Zaar, of Smith River. (See Union Copper Group.) Four hundred tons of ore from a 60-foot winze are stated to have averaged 18% copper and $1.50 per ton in gold.

Sanger Peak Copper. A Chicago company, known as the *Claim Holders Association*, did some prospecting, including diamond drilling, on a property in the northeastern part of the county a few years ago. Little could be learned regarding the work. The deposit is presumed to be in the vicinity of the Preston Peak Mine, on which considerable work was done by Boston parties previous to 1901, when it was closed down. Preston Peak is in T. 17 N., R. 5 E. This district is the best reached by road and trail from Waldo, Oregon.

Schofield Copper Mine (formerly *Klondike Group*). There are 10 claims in this property, namely, Goss, Hooligan, Leander, Hard-to-Beat, Ida, Crescent, Klondike No. 1 and No. 2, and Bear Woller. They are situated in the Monumental district, at the head of Patrick Creek, in Sec. 14, T. 18 N., R. 3 E., H. M., the nearest town being Waldo, Oregon. The Grants Pass road passes within one mile. The claims are within the Klamath National Forest, and are well-timbered. Elevation, 1500 feet. Three veins have been exposed, the principal one being of quartz, four to five feet in width, carrying marcasite and chalcopyrite with some gold values. A 300-foot tunnel cuts this vein at a depth of 150 feet. The deposit has been proved on the surface for 3000 feet. Mining, which amounts to little more than assessment work, is done by hand. The camp buildings are good. Owned by John Schofield, Crescent City, who has held the group since 1910.

Superior Copper Mine. Formerly known as the Atlantic Pacific Copper Mine. It comprised 14 claims, adjoining the Salt Lake-California Mine on the north, and is described in Report XIV of the State Mineralogist. Two claims of this group are now included in the Union Copper Group, owned by Frank Zaar, and the rest have been abandoned. It was a small producer in the past.

Union Copper Group. Owner, Frank Zaar, Smith River, California. The group includes eight claims of the former Salt Lake-California Copper Company's holdings and two claims, formerly a part of the Superior Copper Mine, taking in the principal workings in the Low Divide district. They include the Copper King, Daisy, Bonanza, Union No. 1, No. 2 and No. 3, Mammoth No. 1 and No. 2, Turner, and Gaine, all lying north of and adjoining the Alta California property. The elevation is 1800 feet. They are situated at the head of Copper Creek, a branch of Rowdy Creek, which furnishes a water supply. There is some timber suitable for mining purposes on the claims. The principal copper-bearing lode, which strikes north, passes from the Alta California through the Union No. 1, Union No. 2, Union No. 3, and Mammoth No. 1 claims. On Union No. 1 there is a 450 crosscut adit which cuts the orebody. The vein was drifted on several hundred feet each way and most of the early production was stoped from this working. There is also an upper tunnel, 120 feet in length, on this claim with drifts north and south 40 feet in length. On Union No. 2 there is an open cut, and on Union No. 3 a 100-foot shaft. Mammoth No. 1 claim is developed by a 400-foot crosscut adit, and assessment work is being done mainly in this adit. There is a 4-foot cross vein striking southeast through Bonanza claim and intersecting the main vein on Union No. 3 claim. An adit has been driven 350 feet on this vein, which averages four feet in width, but the ore is not as high grade as that in the north-south vein.

The vicissitudes of mining are vividly brought to mind by a visit to the Low Divide district, now deserted (except for one resident,, Frank Zaar), and it is difficult to avoid 'romancing' when one realizes that over the same road that 5-ton auto trucks transported chrome ore in 1917–1918 "to save democracy," wagon-loads of high-grade copper ore were being hauled out during the Civil War in 1863–64, bound for Swansea and Germany. The once lively copper camp at Altaville, with several hundred inhabitants and some substantial buildings, has completely disappeared. But the mines are still there, and the recent abrupt ending of chrome mining and the cessation of copper mining at an earlier day, have this basis in common: neither operation ceased on account of the mines being worked out. Economic conditions alone have ended mining in the district for the present. Whenever nearby smelters are available, better transportation facilities are obtained, cheaper methods of recovery developed, or the price of copper advances sufficiently, the copper mines will again become active, and, on account of the high average value of the ores, that time may not be far distant.

Perhaps a dozen *other copper prospects* have been described by name in early bulletins and reports of the State Mining Bureau, but owing to abandonments, consolidations, relocations, etc., their identity has been lost. For the most part these were not developed beyond the prospect stage.

Bibl: State Mineralogist's Reports, X, p. 167; XI, p. 198; XIII, pp. 57–58; XIV, pp. 380–386. State Min. Bur. Bull. 23, pp. 111–116; Bull. 50, pp. 133–140.

GEM MATERIALS.

There is occasionally a small production of semi-precious stones and jeweler's materials from Del Norte County. The materials found here consist mainly of agate, chalcedony, garnet, and jasper. Zircons are a constituent of the black sands of the Smith River basin and ocean beach. No particular deposits of gem minerals are known, the material coming from scattered sources.

Bibl: State Min. Bur. Bull. No. 37; Bull. No. 91.

GOLD (LODE MINES).

The output of gold from Del Norte County comes entirely from placer operations. Most of the ores in the lode mines are base, requiring concentration and shipment. With present transportation facilities they are too low-grade to be profitably worked. There is little development work being done other than that required in doing annual assessment work. The deepest gold mine shaft in the county is only 240 feet in depth.

Black Diamond Gold Quartz Mine. Property located at an altitude of 6500 feet near the eastern boundary of the county in T. 14 N., R. 4 E., H. M. It is described in Report XIV of the State Mineralogist (1913–1914). At that time assessment work was being carried on. Nothing was learned regarding recent activities, and it is probably abandoned.

Hard Luck Mine. This mine consists of six claims on Monkey Creek in the Monumental Mining district. The vein is quartz carrying gold and arsenical sulphides. Two crosscut tunnels and several hundred feet of drifts have been run in doing assessment work. A lot of five tons of ore shipped to the Selby smelter by a former owner is said to have assayed $10.40 per ton in gold. Owned by Forester and Bregm, of Tacoma, Washington.

Monumental Consolidated Quartz Mine. Owner, Gunn and Davis Estates; W. F. Williamson, attorney, 11th Floor, United Bank and Trust Company Building, San Francisco. Under option to E. A. McPherson, Waldo, Oregon. This property ranks as the most developed gold lode property in the county, but its early history indicates that it was developed as a promotion scheme and that much money was wasted in the construction of mills, stores and in other ways, that should have gone into legitimate development. The mine consists of eight claims, contining 165.28 acres located in T. 18 N., R. 3 E., in the Monumental district. Elevation, 2560 feet. The vein is quartz, carrying specular iron with gold values and some copper. The walls are diorite and greenstone. Two varieties of ore are found, a hard rock and a softer ore of lower grade. There is a 2-compartment vertical shaft, 240 feet in depth, and an incline shaft to the 100-foot level from the other shaft. Other workings consist of ¾ of a mile of drifts, an upraise from the 100-foot level to the surface and a winze from the 100-foot level; also a number of prospect tunnels from 30 to 40 feet long. All mine machinery has been removed and sold, but the concentrating mill is still on the ground. Power for the mill was furnished by water under 150-foot head through a 6-inch pipe acting on two Pelton wheels. The mine machinery was operated by steam power. The mine has been shut down for about 15 years, but parties are at present looking it over with a view to unwatering the shaft and possibly renewing operations.

Ora Anna Quartz Mine. This property, in T. 16 N., R. 1 E., in the Bald Hills district, is described in Report XIV of the State Mineralogist, 1913–14. It has remained idle during recent years.

Sweet Marie Mine. Property consists of six claims, covering 120 acres on the south fork of Smith River, in T. 14 N., R. 1 E., in the Bald Hills district. Elevation 1500 feet. Owners, Silas White and C. L. Moody, of Crescent City, and G. J. Moore, of Eureka. The deposit consists of a quartz vein averaging four feet in width, carrying free gold and sulphides. Developed by three tunnels, 30, 50 and 70 feet in length. Only assessment work is being done.

GOLD (PLACER MINES).

Small hydraulic and placer workings have been opened up and worked intermittently at many points on Smith River, and its tributary creeks. In addition to the low bars and benches, there are some high gravel deposits at elevations of 2000 feet or more, in the French Hill, Big Flat, and Bald Hill areas.

Dave Savoy Placer Mine. There are 60 acres in this property, which covers a shallow deposit of gravel in the French Hill district in Sec.32, T. 17 N., R. 2 E. A small reservoir is being constructed, and the gravel is ground sluiced when water is available.

Day Hawk Mine. This property includes the former Shelly Creek Saddle Mine and comprises 15 lode and 4 placer claims. Owner, J. W. O'Day, Crescent City, California. The claims are on Shelly Creek, three miles beyond Patrick Creek stage station, on the Grants Pass road. Elevation, 2014 feet. There is good timber on the property and water is obtained from Shelly Creek and from springs. The deposit includes a large porphyry dike, approximately 40 feet in width, striking northwest. Water from the springs has been brought to a small reservoir and is used in sluicing decomposed portions of the dike down the hillside and into sluice boxes. Most of the gold obtained from this work is coarse and rough, but some flour gold is saved also by the use of sacks under the riffles. The gold in Shelly Creek itself is fine, and small amounts of platinum are said to accompany it. The owner works alone most of the time. The dike is said to carry about $9 per ton in gold. The property might develop into a large low-grade milling proposition if this sample does not represent merely surface enrichment.

Dr. Young Hydraulic Mine. Property consists of four claims adjoining J. M. Darnell's mine in the French Hill district, in Sec. 32, T. 17 N., R. 2 E. Idle.

Elkhorn Hydraulic Mine. This property originally consisted of 2560 acres at the mouth of Patrick Creek, in Sec. 16, T. 17 N., R. 3 E. It is idle and has been abandoned for mining purposes, and is now under lease for a hotel site.

French Hill Mine. Property consists of 160 acres, in Secs. 32 and 33, T. 17 N., R. 2 E., in process of being patented. This is the best developed mine in the French Hill district and has been held by the present owner, J. M. Darnell, since 1898. A water supply of 500 inches under 150-foot head has been brought in from Craigh Creek, and hydraulicking has been carried on at two pits, No. 2 giants being used. In the lower pit the gravel has a depth of approximately 25 feet. Some platinum is obtained with the gold. A large acreage still remains unworked.

George Cook Placer Mine. Is situated on the Middle Fork of Smith River, about three miles below Adams Station. Considerable hydraulicking has been done on both sides of the river. The gravel has a depth of about 25 feet and has yielded a fair return in gold and some platinum. Operation has been very irregular.

George Washington Placer Claims. Property is on Monkey Creek adjoining the Monkey Creek Mine, the two comprising about 480 acres. There has been no mining done recently.

Kaus Placer Mine. Owned by Antone Kaus, and situated on Craigh Creek, in Sec. 1, T. 16 N., R. 1 E. The deposit consists of low benches and creek gravels which are worked intermittently by ground sluicing, yielding coarse gold and platinum.

Marshall Mine. Charles Marshall, of Crescent City, care Patrick Creek Station, recently located a placer gravel deposit on Siskiyou Fork of Smith River in T. 17 N., R. 3 E.

Monkey Creek Placer Mine. This property on Monkey Creek, adjoining the George Washington, is idle. It is now owned by Elmer Jenkins and Fred Haight.

Morgan Mine (formerly *Aurora Hydraulic Mine*). Property consists of the Linden No. 1 and No. 2, Moore Gulch No. 1 and No. 2 placer claims, the Gray Quartz lode claim, and a 160-acre homestead; 260 acres in all. It is located in the French Hill district, in T. 16 N., R. 1 E., at an elevation of 1600 feet. There is a road from Crescent City, the nearest town to the property. There are springs on the property, but the supply of water for mining is limited. The deposit consists of high bench gravel, mostly small and in places partly cemented. The average depth is from three to ten feet, and it is from 300 to 400 feet wide. The gold is heavy, often running from 25¢ up. It is equipped for small scale working. Owner, J. L. Morgan, Crescent City, who works it intermittently.

Morrell Placer. The Morrell property is on French Hill, adjacent to the French Hill and Morgan Mines. It consists of a similar high bench gravel deposit. Equipped and worked in a small way. Owner, H. H. Morrell.

Myrtle Creek Hydraulic Mine. Property consists of 18 claims along Myrtle Creek in Secs. 3, 4, and 10, T. 16 N., R. 1 E. The Myrtle Creek Placer Mining Co. is now defunct and the property is idle. The pay gravel is covered with a heavy, nearly barren overburden, forming a high bank, and the recovery is said to have been insufficient to pay for handling such a large quantity of material. The black sands carry platinum.

Nels Christianson Mine. Property consists of 174 acres, mostly bench gravel, near the forks of Smith River, some of which is farmed, but hydraulicking of the gravel benches is usually carried on each winter. A little platinum occurs here with the gold.

Oak Flat and East Fork Groups. Property consists of 270 acres on Patrick Creek, covering bench and creek gravels. Owned by F. F. Raymond and Sons, of Patrick Creek. Some heavy nugget gold has been found on the claims, but the ground has never been more than prospected. The new highway being constructed up Smith River will divert travel from the old road which crosses this property at Patrick Creek Station, and with the practical abandonment of this stage stop, and the probable removal of the hotel to a point on the new highway, real mining operations may be initiated. The ground is reported to be under lease to J. W. O'Day, Crescent City, and the Harris Engineering Co., 502 Haas Building, Los Angeles.

Bibl: State Mineralogist's Reports, VIII, p. 163; X, pp. 166–168; XI, pp. 195–199; XII, pp. 100–101; XIII, pp. 126–130; XIV, pp. 386–390; XVIII, p. 295. State Min. Bur. Bull. 85, pp. 55–64; Bull. 92, pp. 69, 83–85.

IRON.

Magnetite is one of the major constituents of the black sands of the Smith River basin. It also occurs in the beach sands at Crescent City, and masses of pure magnetite are found in the French Hill district. Hematite also has been noted, but none of these occurrences can be considered as commercial deposits of iron ore.

PLATINUM.

Platinum and allied metals of the platinum group are obtained as a by-product of the placer gold mines. Occurrences of the metal are considered herein under the headings, Black Sand and Gold Placer Mines. C. A. Logan[1] has discussed the platinum resources of the county in detail. Other references are given in the bibliography under Black Sand.

QUICKSILVER.

Quicksilver ore in small quantities has been found in T. 18 N., R. 2 E., H. M. Another ocurrence of considerable size and possible commercial value is located on Diamond Creek in T. 18 N., R. 2 E.

Diamond Creek Cinnabar Co. J. W. Ehrman, I. L. Cole, and John Taggart, of Monumental, located three claims on the Diamond Creek deposit in 1916. The claims are four miles south of the California-Oregon line and 18 miles from Monumental, all but three miles being by road. The ore occurs in quartz between serpentine walls and is found in rich bunches with a general north-south trend. The orebody is said to be eight feet wide and to overage 1%–2% mercury. In 1917 a 3-pipe Johnson-McKay retort was installed with a daily capacity of one ton. A small amount of ore was put through, and a little quicksilver recovered. Shortly after starting, however, the retort was burned out and operations ceased. Nothing is being done at the mine at the present time.

---

[1] Logan, C. A., Platinum and Allied Metals in California, State Min. Bur. Bull. 85.

Bibl: State Mineralogist's Reports, XI, p. 198; XIV, p. 390. State Min. Bur. Bull. 27, p. 195; Bull. 78, p. 41. U. S. Geol. Survey Mon. XIII, p. 366; Min. and Sci. Press, Vol. 29, Aug. 15, 1874.

STONE INDUSTRY.

There are no permanent commercial crushed rock or sand and gravel plants in Del Norte County.

George Hood, Crescent City, has a small rock crusher and can supply broken rock in limited quantity. The demand is small.

A. D. Kern Construction Co. Address, A. D. Kern, 290 E. Salmon Street, Fulton, Oregon. There is a large output of rock, which is being used on the construction of the government breakwater at Crescent City, about 210,000 tons having been placed here since 1920. Contracts are let as funds for the work are appropriated, and plants and equipment are installed to correspond. The rock being used at present on the Crescent City breakwater is tentatively classified as an altered grano-diorite. The quarry is on a prominent point jutting into the ocean about three-quarters of a mile northwest of Crescent City, known as Preston Island quarry. The broken rock is loaded on cars by derricks and hauled over a 2-mile railroad to the breakwater by a dinky locomotive.

Webber Construction Co., Crescent City. This company has a number of contracts on the new highway being constructed along Smith River from Adams Station north, of which about 11 miles have been completed and surfaced with crushed rock. The company operates several rock crushing and screening plants in connection with their highway work. These are located at advantageous points as regards getting a suitable character of rock and proximity to the job, and the plants and construction camps are moved as the work progresses.

HUMBOLDT COUNTY.

By C. McK. Laizure, Mining Engineer.

Introduction.

This county, like Del Norte, originally formed a part of Trinity County.[1] When Humboldt County was separately organized in March, 1853, all of its boundaries were fixed approximately in their present position except the north one. This first ran from the mouth of Mad River easterly to a point near the junction of the Trinity River with its south fork. It remained there until 1875, when Klamath County was disorganized and part of its area added to Humboldt. When this addition was made Humboldt County attained very nearly its present form, and its boundary lines, except for a few minor changes, became identical with the present ones.

Geography.

Humboldt is one of the north coast counties, adjoining and lying just south of Del Norte. It is bounded on the east by Siskiyou and Trinity counties, Mendocino County borders on the south, and the waters of the Pacific define its western limit.

It has a length of 100 miles from north to south; this being about three times its width. The county contains 3634 square miles, and its population is 37,857 (1920 census). For many years it was without rail connection with the rest of the world and dependent upon ocean and highway for transportation facilities. This condition was remedied in 1914, when the Northwestern Pacific Railroad was completed through to Eureka. Situated on Humboldt Bay and with an excellent harbor, Eureka, the county seat, is the largest city and the principal port in the north end of the state.

Much the greater part of Humboldt County is rugged and mountainous, numerous roughly parallel ridges and spurs of the Coast Range traversing it in a general northwesterly direction. There is an abundance of water, the Klamath River, Trinity, Mad, Van Dusen, Eel and South Fork Eel Rivers, Mattole River, and numerous smaller streams flowing through the county for many miles. Their general course is northwest, parallel with the structural axis of the mountain ranges.

Its forests are at once the most striking and probably the most valuable single natural resource. Humboldt County being famous for its wonderful groves of giant redwoods and enormous stands of other timber. Dairying, agriculture, mining, and commercial fishing are also important industries.

Geology.

Sedimentary formations extend from the Mendocino County line north along the coast to a point about five miles north of Arcata. They cover a strip about 12 miles wide at the south end. Where the belt crosses the Humboldt Base Line, the formations have a width of 30 miles, gradually running out to a point at the north. In the southern part the rocks consist of massive marine sandstones, with some shale and limestone beds all of Cretaceous age. The northern part is composed of clay shales and sandstone of Tertiary age, with small areas of Quaternary sands, gravels and clays, notably along the lower reaches of Eel River. The eastern boundary of these sediments runs a little west of north. In contact on the east and covering all the southeastern portion of the county, and extending northwest to Rocky Point above Trinidad, there is a belt of Franciscan sandstone, chert and serpentine, about 12 miles in width. A long, narrow strip of Cretaceous shales, with lenses of sandstone three to four miles wide, borders the Franciscan on the east. It enters the county on the southeast at Humboldt Base Line, trends northwest and passes out at Stone Lagoon, near Orick.

---

[1] Coy, Owen C., California County Boundaries, California Historical Survey Commission, Berkeley, Cal.

All that portion of the county lying north and east of this belt is composed of Jurassic, Paleozoic and pre-Cambrian metamorphic and intrusive rocks, including limestone, schists, slates, extensive masses of serpentine, diorite and other crystalline rocks. Most of the gold and copper deposits occur in this area.

Mineral Resources.

The wealth and prosperity of Humboldt County are obviously dependent upon the output and utilization of those natural resources with which it is so bountifully endowed. The most accessible of these assets is timber and it is not surprising that large amounts of capital have been invested in lumbering and its allied industries. Had an equal sum been devoted to the development of its mineral resources, the mining industry would no doubt rank much higher today than it does; how much, no one can say.

The area that was one organized as Klamath County and later dissolved because of natural barriers to communication and travel still remains a little-known and almost uninhabited empire whose virgin resources are just beginning to attract their due share of attention.

Metal and nonmetallic minerals are included in Humboldt County's mineral resources. The county also contains promising oil-producing formations, which compare favorably with any other area in the state lying outside the known structures of proved fields.

Gold has been the chief metal mined and miscellaneous stone the most important nonmetallic. Both of these have been produced to the value of several million dollars each since 1880, when the compilation of county records by the State Mining Bureau was begun. Much gold was also taken out in the preceding thirty years, of which there is no public record. The county contains known resources of black sands, chromite, coal, copper, clay, gem materials, granite, iron, limestone, manganese, mineral water, natural gas, petroleum, platinum, silver, volcanic ash, miscellaneous stone and sand and gravel. Other minerals found here, at least in limited amounts, are barite, cinnabar, graphite, talc and magnesite. The last general report on the county's mines and minerals was published in State Mineralogist's Report XIV, 1913–14. The copper resources were described in Bulletin No. 50, Copper Resources of California, 1908. Platinum and allied metals are covered in Bulletin No. 85, 1918 (out of print); placer gold deposits in Bulletin No. 92, 1923; and manganese and chrome properties are mentioned in Bulletin No. 76, 1918.

Bulletin No. 89, 'Petroleum Resources of California,' with special reference to unproved areas, contains a detailed discussion of the oil possibilities. An earlier report is contained in Bulletin No. 69, 'Petroleum Industry of California,' 1914 (out of print). Both these reports are accompanied by maps. The finding of unbroken folds and structure favorable to the accumulation of oil in quantity appears to be the key to commercial production in this county. As the petroleum industry is distinct from other branches of mining, requiring specialized study, no attempt was made to include it herein.

The writer spent ten days during June, 1925, in gathering notes on present mining operations in the county and collecting data regarding new discoveries and developments. Some material published in earlier reports has been included in the case of properties that were idle, in order that this report might be as comprehensive as possible.

The hearty cooperation of members of the Eureka Chapter of the American Association of Engineers is gratefully acknowledged. Some 80 engineers, representing nearly all branches of the profession, most of whom are associated directly or indirectly with the lumber industry, comprise its membership. Their assistance added materially to the ground that could be covered in the short time devoted to field work. The Eureka Chamber of Commerce is to be congratulated in obtaining the voluntary services of this body in making a study of the county's industrial needs that is under way.

In 1924 Humboldt County ranked 34th among the fifty-eight counties of the state in the value of its mineral output. Nine mineral substances, having a value of $485,478, were produced. The total recorded mineral output from 1880 to 1924 is given in the following table:

HUMBOLDT

Year	Gold, value	Silver, value	Mineral water		Brick	
			Gallons	Value	M.	Value
1880	$153,940	$80				
1881	75,000	300				
1882	100,000					
1883	80,000					
1884	115,000					
1885	29,730					
1886	83,591					
1887	111,532					
1888	100,000					
1889	143,701	274				
1890	93,612	82				
1891	99,329	19				
1892	87,515					
1893	66,354					
1894	41,326	14	20,000	$7,200		
1895	92,635		24,000	12,000		
1896	65,093		15,000	10,000		
1897	94,992	57	10,000	2,000		
1898	57,512				300	$2,500
1899	65,059		6,000	1,500	410	3,870
1900	109,444	[1]136	6,000	2,000	795	7,100
1901	98,487	[1]59	7,825	2,000	1,005	7,810
1902	60,015		10,000	2,500	2,170	17,040
1903	38,509				1,060	10,445
1904	62,061				2,565	21,350
1905	45,824				800	7,600
1906	48,295	240			915	8,690
1907	40,109	214			140	1,400
1908	33,066	325			760	8,585
1909	25,690	94			1,310	9,750
1910	35,289	150			476	4,048
1911	34,966	169			357	2,880
1912	31,271	150			772	6,415
1913	25,611	132			500	4,150
1914	18,686	57			607	6,120
1915	15,947	62	2,000	500	463	5,565
1916	21,279	55	3,000	750	[2]	
1917	23,086	95	[2]		[2]	
1918	8,028	72	[2]		[2]	
1919	16,260	134	[2]		[2]	
1920	2,538	19			[2]	
1921	2,054	37				
1922	1,330	10	[2]		[2]	
1923	2,260	12	[2]		[2]	
1924	1,269	7	[2]		[2]	
Totals	$2,557,295	$3,055	[2]$103,825	$40,450	[2]15,405	$135,318

---

[1] Recalculated to 'commercial' from 'coining value' as originally published.

[2] See under 'Unapportioned'.

[3] Includes crushed rock, rubble, rip-rap, sand, gravel.

COUNTY, 1880-1924.

Miscellaneous stone[3], value	Natural gas		Miscellaneous and unapportioned		
	M. Cu. Ft.	Value	Amount	Value	Substance
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
$199,240	-----	-----	-----	-----	
251,586	-----	-----	-----	-----	
233,454	-----	-----	-----	-----	
193,502	-----	-----	-----	-----	
297,276	-----	-----	-----	-----	
160,845	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	$362	Platinum.
-----	-----	-----	-----	140	Platinum.
-----	-----	-----	12.5 ozs.	204	Platinum.
-----	-----	-----	30.8 ozs.	555	Platinum.
-----	-----	-----	-----	-----	
13,074	-----	-----	1,280 cu. ft.	1,280	Granite.
29,170	600	$300	2,450 tons	7,640	Clay.
			-----	20,985	Unapportioned, 1900-1909.
36,700	1,000	500	250 tons	750	Clay.
37,756	300	150	937 tons	937	Clay.
229,730	300	150	396 tons	400	Clay.
439,808	300	150	7,750 lbs.	1,201	Copper.
208,204	300	150	3 ozs.	115	Platinum.
335,292	[2]	-----	-----	1,320	Copper and natural gas.
60,260	[2]	-----	7 ozs.	296	Platinum.
			-----	192,255	Brick, clay, granite natural gas.
			6 ozs.	351	Platinum.
27,014	[2]	-----	-----	9,312	Brick, clay, mineral water, natural gas, volcanic ash
			370 tons	21,744	Chromite.
			210 tons	420	Clay.
51,082	640	85	-----	116	Granite.
			1,520 tons	57,751	Manganese
			2 ozs.	140	Platinum
			-----	2,516	Brick, mineral water, pumice.
25,198	[2]	-----	-----	9,271	Brick and clay.
			-----	1,148	Mineral water and natural gas.
			859 tons	18,513	Manganese.
133,290	[2]	-----	-----	5,436	Brick, clay, granite, mineral water, natural gas, volcanic ash
131,688	[2]	-----	75 tons	190	Pottery clay.
			-----	4,628	Brick, mineral water, natural gas, platinum, pumice
			-----	6,399	Brick and clay.
117,308	[2]	-----	-----	153	Mineral water and natural gas.
			4 fine ozs.	413	Platinum.
422,519	[2]	-----	-----	9,915	Clay and clay products, mineral water, natural gas, platinum.
476,449	[2]	-----	-----	7,753	Brick, clay, mineral water, natural gas, platinum.
$4,110,445	[2]3,440	$1,485	-----	$384,494	

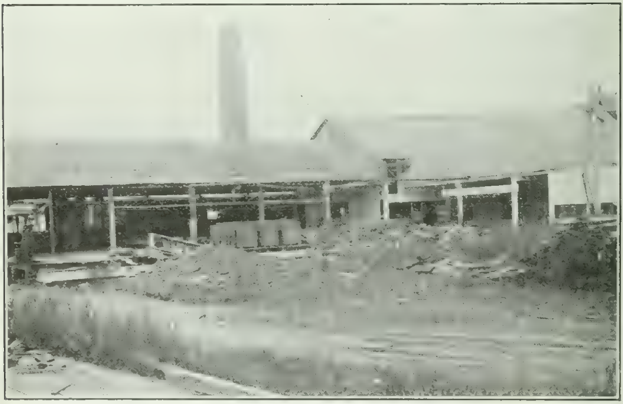
BARITE.

The occurrence of barite in Humboldt County has not heretofore been of record.

Liscom Hill Deposit. Near the summit of Liscom Hill, eight miles northeast of Arcata and not far from Blue Lake,, a number of veins of white crystalline barite have been noted. The veins run from a few inches to one foot in width, standing nearly vertical. Good size boulders of barite in the vicinity indicate that development work might uncover a deposit of commercial size. The deposit is on patented land.

BLACK SAND.

In former years the beach and bluffs of northern Humboldt County were successfully worked at Upper and Lower Gold Bluff, Big Lagoon and Little River. The gold was fine and was saved by use of the Oregon tom, ordinary tom and amalgamating plates. After the tide had receded, pack mules were taken down and the sand packed away in sacks for washing. Many thousands of dollars were taken out in this manner, but for some reason the gold no longer concentrates in paying quantities, and all work of this kind has been abandoned.



Plant of Thompson Brick Co., Eureka, Cal.

The sands and gravels of Klamath River carry a good percentage of black sand, generally having a gold and platinum content. With ordinary hydraulic operations some or all of these values are lost, but where special effort has been made to collect and clean the sand some production of fine gold and platinum has resulted. Outside of such incidental recovery at the hydraulic mines and a few ounces obtained by hand work by individuals, very little has been done with the black sands in recent years.

Bibl: State Mineralogist's Report XIV, p. 391; State Min. Bur. Bull. 45, Bull. 85, Bull. 92; U. S. Geol. Survey Bull. 260, Bull.

285, Bul. 315; Mineral Resources, 1905; Geologic Folios 89, 73; U. S. Bur. of Mines Tech. Paper 196.

California-Oregon Metals Co., address, 1014 Santa Fe Building, 605 Market Street, San Francisco. This company installed one of their machines embodying the McBride process on the beach at Gold Bluff north of Orick during the past year, principally for the purpose of perfecting the machine and process and for experimental research. The black sand at this point was said to carry 40 cents per ton in gold and platinum. The results of the test were reported as showing that a satisfactory percentage of recovery could be made, but the general tenor of the sands was too low to make operations commercially satisfactory.

BRICK AND TILE.

Several brick and tile plants have been operated in the county in the past; one at Fortuna and three at Eureka, but the market that can be reached is limited. The Fortuna brick yard, the Humboldt Clay Manufacturing Company and others which formerly operated yards in Eureka, are now out of business.

Thompson Brick Co. (formerly Eureka Brick and Tile Co.). J. D. Thompson, president and owner, Myrtle and Harrison streets, Eureka. This property contains 6.18 acres, located on Eureka Slough, 1½ miles from town. There is a wharf at the plant. The clay used is dug on the property. The deepest excavation is 12 feet, but good clay probably extends to a much greater depth in places. A tractor with Fresno scraper is used to dig the clay. It is dumped in a hopper and elevated from there to a pug mill and disintegrator. From the pug mill the material is fed to a Brevan stiff-mud wire-cut machine, which delivers the green brick or tile to boards for stacking and drying. They are allowed to air-dry about two weeks and are then burned in a 30-foot round, down-draft kiln, having a capacity of 75,000 brick. Wood and oil are used for fuel, the oil at the finish of the burn, which takes place at a temperature of 1850°. Steam power is used to operate the machinery. Eight men are employed when running at full capacity, which is 15,000 bricks per day. The market for the product is mainly within the county.

CHROMITE.

No chrome ore was produced in Humboldt County previous to 1918, but the war demand at that time resulted in the opening up of a deposit on the property of the Horse Mountain Copper Co. (see also under Copper). Chromite is also a constituent of the black sands of the beach and placer concentrates. It is said to occur massive near Blockburg, and there are small bodies on Hoopa Indian Reservation.

Horse Mountain Copper Co. The chromite here occurs in a series of lenses, which may be continuous, lying near the top of the ridge at an elevation of 4600 feet, and exposed along the axis for a considerable distance. The deposit was mined in 1918 at two points about 9000 feet apart by open cut methods with pick and shovel. Several hundred tons of ore, averaging 40% to 45.5% Cr_2O_3, were shipped before operations ceased on account of the collapse of the chrome market. There is undoubtedly a large tonnage still available on this property.

Bibl: State Min. Bur. Bull. 76, p. 148; Bul. 91, p. 109.

CINNABAR.

E. F. Miller, of Orleans, made some locations about 1915 on a vein carrying cinnabar in the Mill Creek district south of Orleans. Only a small amount of development work has been done.

Bibl: State Min. Bur. Bull. 78, p. 46.

CLAY.

A detailed report on the clay resources of the state is in preparation by Prof. W. F. Dietrich, of Stanford University. Field work was begun in the southern part of the state. When completed this report will be published as a special bulletin by the State Mining Bureau. At the present time little definite information is available regarding the clay resources of the north coast counties, including Humboldt. Clays, suitable for the manufacture of common brick and tile, are doubtless abundant. Pottery clays are known to exist, at least in limited quantities. These have been utilized commercially only in a small way and for experimental purposes.

Loofbourrow Clay Deposit. On property owned by Dr. T. L. Loofbourrow, First National Bank Building, Eureka, situated four miles south of Eureka and ¼ mile east of the highway. There is a deposit here of dark-blue, smooth plastic clay said to average 22 feet in depth over ten acres. The blue clay is overlaid by four to six feet of yellow clay.

The composition of the blue clay is given in the following analysis by Harry A. Duffy, of Eureka:

Loss on ignition	22.30%
SiO_2	42.80%
Al_2O_3	38.24%
Fe_2O_3	2.60%
Na_2O	2.40%
CaO	3.34%
K_2O	4.41%
MgO	3.01%
Organic substance	3.20%

A bed of high-grade clay is found on the *W. A. Preston* holdings (see under Iron). Some of this has been used by R. H. Jenkins, of the Humboldt State Teachers College at Arcata, in the production of pottery and for experimental purposes. Mr. Jenkins has worked with a number of Humboldt County clays.

Weatherby Ranch Deposit. There is a deposit of clay of unknown extent on property of the Hanify Lumber Company, four miles south of Elk River, under lease to Clarence Weatherby, Elk River, via Eureka. The strata exposed in a cut on a ridge through the property shows clay underlaid with two feet of fine volcanic ash. Underneath the ash is six feet of yellow clay, then two feet of lignite coal, with clay again below the coal. Some production of volcanic ash has been made, but the coal and clay have not been developed. The Hanify Lumber Company's railroad runs within ¼ mile of the deposit.

COAL.

Coal has been known to exist in this county since the early sixties. From time to time new localities where it occurs have been reported and placed on record, but no commercial developments have ensued to date. Conditions up to the present have not been such as to encourage exploitation even of the most promising showings. Lignite coal in quality comparable with much of the lignite found throughout the state can no doubt be produced here whenever a definte demand for this fuel appears. The commercial value of the deposits will remain undetermined, however, until considerable exploration work has been done.

A list of the known occurrences is given herewith, with brief notes concerning the character of the deposits.

(1) Within the city limits of Eureka, near Twelfth and L streets. The strata from the surface down showed:

a. Sand, 16 feet.
b. Lignite, 18 to 24 inches.
c. Clay, 4 feet.
d. Lignite, 1 foot.
e. Clay, 3 feet.
f. Clay with shells, 1 foot.
g. Clay, 11 feet and deeper.

A brickyard was established here at one time. The clay was used in making brick and some of the lignite was utilized to help burn them. The material had to be dried before used, and was of poor quality.

(2) On Sec. 29, T. 5 N., R. 3 E. The first patent taken out for coal land in the Humboldt Land District was for 80 acres in Secs. 20 and 29, T. 5 N., R. 3 E., covering this deposit. The vein strikes N. 45° W., and dips about 45° NE., between walls of argillaceous sandstone. An old shaft was sunk about 45 feet following the dip of the vein on the bank of Maple Creek, where the vein crosses the creek. The shaft is caved and filled up but a small pile of coal remains. Pieces were readily ignited and burned to a fine gray powder. An old tunnel across the creek driven on the vein is also caved and the only exposure at present is in the creek bed. Pieces broken from here showed the coal to be a tough brownish-black lignite. The width of the vein is difficult to determine, but apparently there is from three to four feet of coal. Crogan Creek joins Maple Creek a few hundred yards above here and considerable float is found in Crogan gulch indicating the presence of another vein. The composition of the Maple Creek coal is given as follows:[1]

Water	11.75%
Volatile carbonaceous matter	46.80%
Fixed carbon (does not coke)	29.60%
Ash	11.85%

---

[1] State Mineralogist's Report VII, p. 187.

Analyses of three samples from the Maple Creek deposits by Mathyas[1] show:

	a	b	c
Water	12.25%	14.00%	14.25%
Volatile matter	50.75%	49.80%	53.75%
Fixed carbon	31.00%	32.95%	29.50%
Ash	6.00%	3.25%	2.75%

Coking qualities: None.

This deposit is within a few miles of a lumber company's railroad, and is one of the best coal showings so far noted in the county.

(3) Lignite has been reported to occur two miles north of Arcata. There is nothing definite known regarding this locality.

(4) On the Upper Mattole, in Sec. 12, T. 3 S., R. 1 W. Several small beds six to eight inches thick. The strata have a slight dip to the north. No development.

(5) On Eel River, two miles below Alder Point. An 8-inch seam occurs here from which a few sacks are reported to have been taken and used for blacksmith work.

(6) On Jacoby Creek, four miles from Humboldt Bay. Thin seams.

(7) Occurrences reported on Larribee Creek, in Sec. 26, T. 1 S., R. 4 E., also in Secs. 2, 3, 10, 11 and 21, in the same township and range.

(8) On Eel River, opposite Eagle Prairie.

(9) On the Van Dusen, three to four miles above Bridgeville.

(10) On Yager Creek, 1 mile above Hydesville.

(11) Traces have been noted on the South Fork of Eel River, one mile north of Garberville.

(12) On Bear Creek, one mile east of Garberville.

(13) On Panther Gulch, a tributary of East Branch South Fork of Eel River.

(14) On Buckmountain Gulch, a tributary of the East Branch of South Fork Eel River, a bed two feet in thickness is reported. It has been used locally in forges with good results.

(15) In T. 4 S., R. 4 E., six or seven miles south of Garberville, on the East Branch of South Fork of Eel River. The coal bed here is said to be three to four feet thick. It dips 50° W. An analysis[2] shows its composition to be:

Water	10.75%
Volatile carbonaceous matter	48.50%
Fixed carbon (firm coke)	38.30%
Ash	2.45%

Ash is a light yellow powder. This coal cokes well.

It has a good luster and is apparently free from pyrites. This may be the same bed noted under (14). Some work has been done here in the past.

(16) Lignite has been found on the Hoopa Indian Reservation.

(17) Coal was uncovered recently in a cut made for a culvert in the highway near Miranda, on the property of W. E. Sinclair of Miranda. It was covered up during construction work without further investigation.

(18) A 2-foot vein of lignite occurs with clay and volcanic ash on the Weatherby Ranch, four miles south of Elk River. Not developed.

---

[1] State Mineralogist's Report XII, p. 64.

[2] State Mineralogist's Report VII, p. 188.

At least two or three of the localities mentioned have showings that are worthy of further investigation by anyone interested in the utilization of lignite coal; a matter which is receiving increased attention throughout the country.

COPPER.

For many years Humboldt County has held promise of becoming one of the copper producing counties of the state. The belt of Paleozoic metamorphic rocks in which the copper deposits in Del Norte County occur extends north into Oregon and southeasterly through Humboldt and western Trinity counties. Throughout this belt there are scattered deposits of copper ores. Considerable development work has been done in Humboldt County on some of these, but the output of copper has been small. Lack of cheap transportation for shipping ores and inability of the owners of deposits to provide adequate concentration or reduction plants has kept the copper mining industry practically at a standstill. The principal copper prospects and mines are in Red Cap Creek district, Mattole district and at Horse Mountain.

Red Cap Mine. This property is in Sec. 29, T. 10 N., R. 6 E., on the high ridge betwen Red Cap and Boise creeks. Rich float, consisting of native copper and bornite, was found here. In 1880 considerable money was spent in prospecting without locating a definite vein; the ore apparently occurring in bunches and as pockets in the serpentine.

The *La Perin group* consisted of ten claims adjoining the Red Cap Mine. There has been no activity at either of these properties for years.

In the Mattole district two properties are of record at which some work was done in early days. These were the *Rainbow group* in Secs. 19, 30, and 32, T. 1 S., R. 1 E., and Secs. 12 and 19, T. 1 S., R. 1 W., and the *Crimson group* in Sec. 8, T. 2., R. 1 E. Nothing has been done at these properties for years.

Vance Property. A ledge said to be eight feet wide, striking northwest and dipping 70° southeast, has been exposed in Sec. 24, T. 3 S., R. 3 E., on property owned by Harry Vance, of Eureka. The ledge carries pyrite, which may be auriferous, and traces of copper. No work has been done on it, and its extent is unknown.

Horse Mountain District.

Subsequent to the activities in the Red Cap and Mattole districts, copper was discovered on Horse Mountain in the Hoopa Range, which forms the divide between Wood Creek and Trinity River. The most promising and important deposits in the county have since been developed on Horse Mountain. Four properties are described in Report XIV of the State Mineralogist (1913–14). These are the Horse Mountain Copper Mine, the Humboldt Copper Mine, Sweet Home Copper Mine, and Ruby Copper Mine. All of these properties have been absorbed by the Horse Mountain Copper Company, which now controls a large area covering the principal deposits.

The Horse Mountain Copper Mine was recently examined by Mr. James B. Knight, of El Paso, Texas, who kindly placed his data and maps at the disposal of the writer, as well as donating a number of excellent specimens of native copper and high-grade ores to the Mining

Bureau museum. The writer is indebted to Mr. Knight for much of the material embodied in this report on the property.

Horse Mountain Copper Mine. This property is owned by the Horse Mountain Copper Company, a California corporation, organized in 1914. B. C. Schnoor, president; Maud E. Moore, secretary; David Wilson, general manager. Home office, 1118 Fourth Street, Eureka, California. The holdings consist of 120 acres of patented land and 100 mining claims having an area of approximately 2000 acres, held by location. The property is in the Trinity National Forest, in T. 6 N., R. 4 E., about 22 miles by airline east of Arcata. By road it is 26 miles from the mine to Korbel from which point there is rail connection to tidewater. All of this road is state highway except 5½ miles between the highway and the mine, which contains grades running from 7% to 11%. The elevation at the mine varies from 5000 feet at the camp to 3350, the lowest point on the property. The winters are mild, but snow occasionally falls on the summit, though not in amount apt to interfere with mining operations. Pine, fir, cedar, and oak are widely distributed over the property; the 120 acres of patented land alone being estimated to contain 4½ million feet of saw timber. An abundance of water for domestic and mill use is obtained from springs so situated that pumping is not required. Tunnel No. 6 provides drainage for all excess mine water and this could be used for mill operations if required.

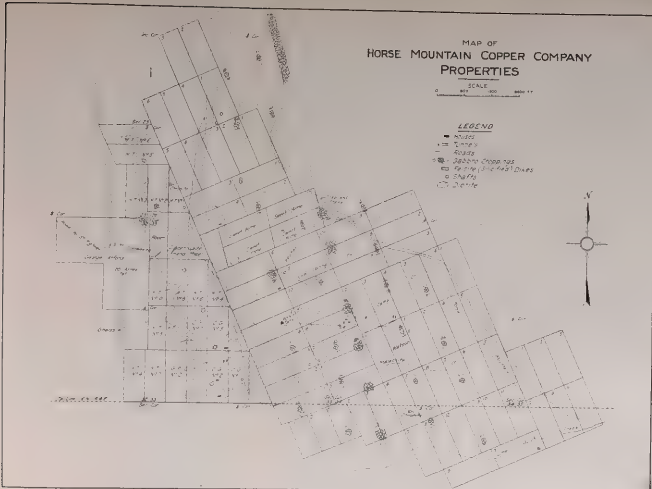
The strike of the ore-bearing formations is northwest with dip to the northeast. The formation is largely serpentine, associated with gabbro, and felsitic and diorite dikes. Much schist has been developed through metamorphic action, schist and diorite forming the principal gangue in the ores. High-grade sulphides and carbonates are widely distributed. Chalcopyrite occurs mainly in the diorite. Chalcocite is common in both the schist and harder diorite. Bornite is found mainly in the schist, with much malachite in the upper workings. Cuprite and chrysocolla are not as common as the other copper minerals. Native copper is widely distributed in the gabbro. The ores average about 30% silicon, 15% lime, and 12% iron. It is estimated that about 12% of the ore produced in quantity will be high-grade (10 to 50% copper), and that 10% of the whole can be sorted to a product carrying 15% copper with the remainder as milling ore averaging 3 to 5% copper. Occasional assays have shown a small gold content, but gold probably does not occur in paying quantities.

Chromite occurs on the property in the serpentine areas. There was some production in 1918 (see under Chromite).

The Western States Gas and Electric Company's power lines pass within seven miles of the mine.

The total tunnel and drift development on the property is 4675 feet, as shown by the following tabulation prepared by James B. Knight.

MAP OF
HORSE MOUNTAIN COPPER COMPANY PROPERTIES



DEVELOPMENT CHART.

Elevation B. M. 5300 feet.

Tunnel No.	Elevation, feet*	Cross-cut, feet	Drift, feet	Cut ore	Length, feet	Remarks
1	500	180	120	Entrance. 4′ ore at 90′ 15′ ore at 140′	300	Carbonates, bornite, chalcocite. Assay, 5 and 10 per cent. Shipped ore.
2	270	150		Entrance.	150	Chalcocite and native copper.
3	600	190				
4	500	700	80 on ore	20′ at 250′ 30′ at 340′ Ore in face.	80 700	Ore shipped to Tacoma Smelter. Bornite, carbonates, chalcocite.
5	100	90		Ore in face. Ore in entrance.	90	Native and chalcocite.
6	940	1,740		L.E. at 150′ Ore at 500′ 15′ at 900′ 3′ at 1,600	1,740	Bornite, chalcocite. Native. Cut diorite at 1,600′ showing chalcopyrite. Low drain.
7	400	90		Entrance and face.	90	Native; chalcocite. Shipped ore.
8	500	Caved—no examination—good grade ore on dump.				
S.H. 1	1,100	Begun as lower drain.			150	Shut down (war).
S.H. 2	750	100			100	Did not reach ore chute.
9A	530	40	60	All in ore.	100	Carbonates, bornite, chalcopyrite, chalcocite. Shipped ore.
9B	570	180	100	50′ ore at 90′. 100′ drift at 115′ on ore	280	Shipped ore. Good grades.
'Ruby'	700	700		11′ ore at 150′ 30′ ore at 500′	700	Native and chalcocite. Native and chalcopyrite.
Shaft (ver.)	400			On ore		Native; chalcocite; oxides.
Drift	550		25	On ore body	60′ wide	Same class as shaft.

"Humboldt Group"—West Side Axis, Diorite Contacts.

Elevation B. M. 5300 feet.

Tunnel No.	Elevation, feet*	Cross-cut, feet	Drift, feet	Cut ore	Length	Remarks
1	500	750		At 500′ air-shaft 185 ′to surface. Ore at 75′. At face chalcopyrite and along floor different points.		
2	550	75	In diorite	50′ of ore	75	Chalcopyrite, gold values.
3	550	50		All in ore	50	Chalcopyrite, gold values.

'CHROMITE.'

From two openings (9000 feet apart) $13,000 of chrome, 40 to 45.75 per cent, was shipped at a profit in 1918. Elevation—425 feet; 700 feet. Total tunnel and drift development, 4675 feet.

In addition to tunnel and drift work, there are at least 50 open-cuts and ground-sluices that have exposed ore bodies of from 3 to 100 feet in width of good milling ore, carrying much high-grade shipping values.

*All elevations read minus (—) B.M. 5300′ above sea.

The location and elevation of the various workings are shown on the longitudinal sectional views. On account of the large size of the orebodies, it is believed that much of the ore could be most economically mined by steam shovel. The Horse Mountain Mine is equipped with a small slime concentrating mill for low grade ores. This was only operated a short time before the mine was shut down at the beginning of the war. The mill test showed the concentrates to contain 20% copper and the middlings about 0.4%. The mill was run by steam power, the equipment including two 50-h.p. boilers; one 14-h.p., one 20-h.p., and one 40-h.p. engine, and a gas engine for furnishing power for mine ventilation. There is also a saw mill and planer, assay office, and bunkhouses and cabins, capable of accommodating 200 employees. When last operated, 26 men were employed underground and on top.

GEM MATERIALS.

Among the beach stones common at Big Lagoon and other localities are garnet, agate, chrysoprase, jasper, carnelian, etc. The commercial output of these is so small and irregular as to be negligible.

GOLD (LODE MINES).

Bonneyville Quartz Mine. The Bonneyville Mining Company, former owners of this group of six claims, is evidently out of existence, and there has been no recent work done on the property. The claims are in Sec. 15, T. 6 N., R. 4 E., near the head of Willow Creek, a tributary of Trinity River.

Golden Eagle. Owner, Frank Schweichler, Orleans, California. This prospect was discovered in 1915. It is in the Red Cap mining district at an elevation of about 1000 feet, with abundant timber and water. The ledge is said to be sixteen feet wide, free milling, and to carry gold, silver and copper.

Little Klondike Mine. Property consists of three placer and four quartz claims adjoining the Red Cap Mine at the head of Red Cap Creek. The quartz vein frequently carries good values in gold. Owner, F. Lubbs, of Orleans. It is worked intermittently.

Pearch Creek Prospect. Consists of one claim on a free-milling quartz vein, 6 to 14 inches in width. It is situated three miles from Orleans on Pearch Creek. The rock is milled in an arrastra, run by water power. Geo. Wilder and Anton Lyons, of Orleans, owners.

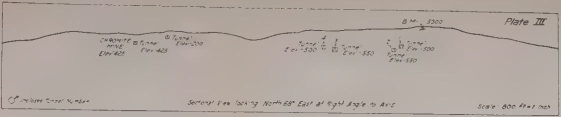
Red Cap Mine. Owned by Red Cap Quartz and Placer Mining Co., J. D. Fleming, president; A. E. Cartwright, secretary, Scotia, California. Ten quartz and three placer claims were formerly included in this group but all have been abandoned except the original three quartz claims. The mine is in Sec. 33, T. 10 N., R. 6 E., on the north fork of Red Cap Creek at an elevation of 2640 feet. The country rock is porphyry and diorite. Four veins, striking northeast and dipping 70° northwest were developed. The ore in the upper levels was free-milling but in the lower levels it is a heavy sulphide, carrying some copper. Recent work has been confined to the lower tunnel which has been driven 550 feet in doing assessment work.

GOLD (PLACER MINES).

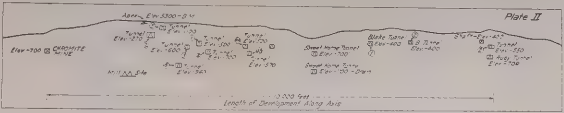
Big Bar and Big Bar Annex. Property comprises five claims covering a bench gravel deposit, located in Secs. 17 and 20, T. 10 N., R. 5 E. It was operated by former owners until 1895, when the flumes were wiped out by landslides. It is now owned by Carl Langford, of Somes

SKETCH SHOWING
DEVELOPMENT OF
**HORSE MOUNTAIN
COPPER COMPANY
PROPERTIES**

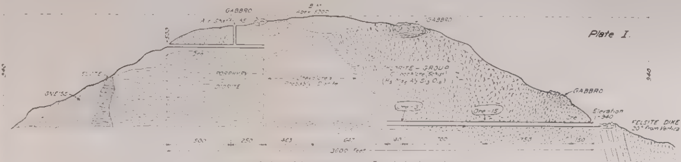
*After Drawing by
JAMES B KNIGHT
April 1925.*



Sectional View looking North 68° East at Right Angle to Axis



Sectional View looking South 68° West at Right Angle to Axis
showing Position and Elevations of Tunnels
B M 5300 Ft – All Elevations minus – ○ Encloses Tunnel Number
Scale 800 Ft = 1 Inch



Cross Section of Axis showing Lowest Tunnel Development
from both sides of Mountain Scale 300 Ft = 1 Inch

Bar. Assessment work only is being done. At the present time a drift is being run on the Big Bar Annex.

Bondo Mine (formerly Croton Bar and Markeson Mine). This property, which originally contained 40 acres, is located in Sec. 29, T. 11 N., R. 6 E., on the Klamath River, 1½ miles above Orleans. The old ditch and flume are out of commission, and in recent years the mine has only been operated on a very small scale. It has lately passed into the hands of W. R. Morres, 421 W. Adams Street, Los Angeles. W. R. Morres et al. have located the following additional claims: E½ E½ of NE¼, Sec. 30; W½ W½ of NW¼, Sec. 29; W½ W½ of SW¼, Sec. 20; E½ E½ of SE¼, Sec. 19; T. 11 N., R. 6 E., and the property now extends to Wilson Creek. Early work on the Bondo paid well, and it is expected that this mine will be rejuvenated.

Bibl: State Mineralogist's Report XIV, p. 401.

Cañon Bar Mine. Owner, Willie Norton, Sr., Hoopa Valley. Nearest town, Weitchpec. This property is on the Indian reservation. It was discovered about 45 years ago, and was hydraulicked off and on up to the last ten years. The property contains 40 acres, of which about one acre has been worked off. The pay gravel has an average depth of four feet.

Cavanaugh Mine. On the Klamath River, three miles above Weitchpec, in Sec. 1, T. 9 N., R. 4 E. Originally located in 1870. Worked in later years only in the winter. Idle at present. C. A. Sample, owner, Fresno.

Bibl: State Mineralogist's Report XIV, p. 402.

Clover Flat Placer Mine. This mine, formerly owned and operated by the Clover Flat Gold Mining Co., consisted of 340 acres in Secs. 17 and 20, T. 7 N., R. 5 E., on the Trinity River, one mile north of Willow Creek. It has been shut down for a decade and the property has now passed into the control of I. M. Jameson, 481 W. Highland Avenue, Sierra Madre, California. It is idle.

Bibl: State Mineralogist's Report XIV, p. 402.

Delaney Group. Property consists of three claims, comprising 60 acres, in Sec. 26, T. 11 N., R. 5 E., covering a deposit of free gravel on Camp Creek, which runs through the claims. There is practically no overburden. The ground is virgin and is said to prospect well. Owner, E. J. Delaney, Orleans.

Elkhorn Mine. Owner, G. F. Willhite, Orleans, California. Property consists of 200 acres, containing bench gravels. The mine is located in the Orleans district at an elevation of 500 feet and is reached by trail having a 6% grade. The county is reconstructing this into a wagon road. Trinidad, the nearest railroad point, is 85 miles southwest. The deposit was discovered in 1915. Red Cap Creek furnishes the water supply. The ground is level and covered with timber, the mine being on the forest reserve. It is equipped with a ditch 4000 feet long, supplying water, under 100-foot head, to pipe and giant. Tailings are run into the river. There is a four-room house. Idle.

Bibl: State Mineralogist's Report XVII, p. 506.

Florence Placer Mine. Consists of one claim of 20 acres in Sec. 31, T. 10 N., R. 5 E., on the Klamath River, three miles above Weitchpec. It was last worked during the winter of 1923–24. Wm. Martin, Weitchpec, owner.

Bibl: State Mineralogist's Report XIV, p. 402.

Golden Rod. Property consists of two claims, the Golden Rod No. 1 and No. 2, having an area of 40 acres. It is located in Sec. 26, T. 11 N., R. 5 E., three miles northwest of Orleans. Elevation, 500 feet. Camp Creek runs through the claims which cover creek and bar gravel deposits. The greatest depth exposed is 25′. There are several back channels and bars which are said to prospect good. There is no overburden. The greater part of the deposit is unworked, but Indians and others ground-sluiced a little in early days. Owners, John A. Hunter and C. S. Little, Orleans.

Klamath River Mine. Property consists of 280 acres in Sec. 1, T. 9 N., R. 4 E., and Sec. 6, T. 9 N., R. 5 E. The claims were first located in 1860. It is owned by the J. W. Proffitt and S. M. Briscoe Estate. Operated by the Klamath River Mining Co. There are two miles of flume which carries 1500 inches of water. An 18-inch pipe serves a No. 4 giant and a 16-inch pipe a No. 3 giant, under 200-foot head. The deposit consists of uncemented medium gravel on schist bedrock. The mine was shut down in June, 1925, on account of lack of water. J. E. Moore, 1033 Fulton Street, Fresno, California, has recently taken it under lease.

Bibl: State Mineralogist's Report XIV, p. 403.

Orcutt Hydraulic Mine. This property is in Sec. 29, T. 11 N., R. 6 E. It consists of one claim covering bench gravels, two miles northeast of Orleans. There is a ditch three miles long which brings in 500 inches of water under 150-foot head. Owned by Ira Orcutt, who works it each winter.

Bibl: State Mineralogist's Report XIV, p. 403.

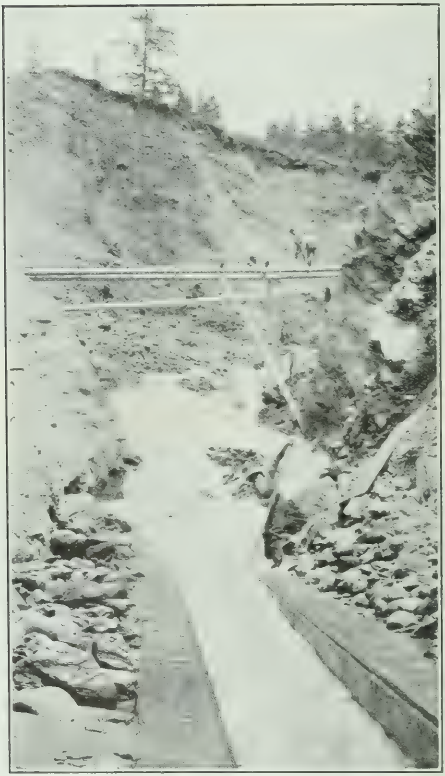
Orleans Bar. This property consists of 1300 acres of patented land and 600 acres of unpatented land, in Sec. 1, T. 10 N., R. 5 E.; Secs. 25 and 36, T. 11 N., R. 5 E.; Sec. 30 and 31, T. 11 N., R. 6 E., on the Klamath River at the town of Orleans. It was last worked in 1913, by the California Mining and Dredging Syndicate, of which Thomas M. Logan was president, H. DeC. Richards, vice president and general manager, and D. F. Hamon, secretary. There is a large area of ground here on both sides of the river, consisting of both high and low bars. Only a small part was worked off before operations ceased.

Bibl: State Mineralogist's Report XIV, pp. 403, 404.

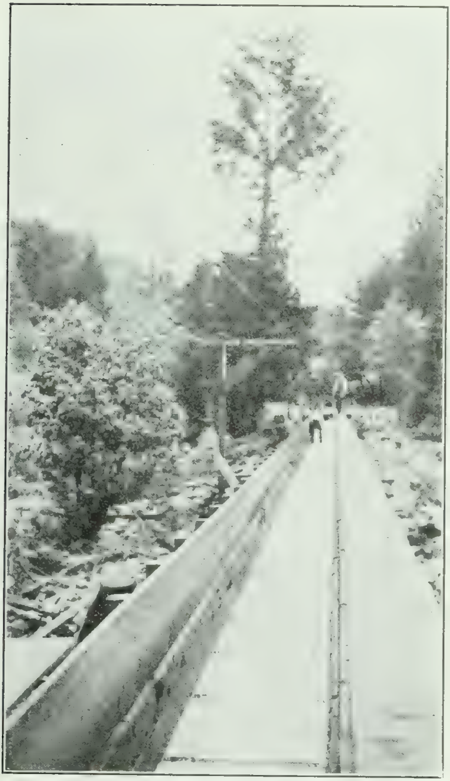
Peacock Mining Co. Frank Knowland, president; Frank M. Wilson, secretary. Home office, Bank of Italy Building, Oakland. John Andrews, mine superintendent, Orleans, California. The company was organized in December, 1922, and acquired the Jonas Salstrom hydraulic mine, consisting of five claims in Sec. 1, T. 10 N., R. 5 E., and Sec. 36, T. 11 N., R. 5 E., $1\frac{3}{4}$ miles southeast of the town of Orleans, together with 95 acres adjoining, known as the Graham patent.

Diversion dam on Camp Creek and flume of Peacock Mining Co., Orleans, Cal. Photo by courtesy of the company.

Hydraulicking at property of Peacock Mining Co., Orleans, Cal. Photo by courtesy of the company.



Bedrock cut and head of sluice, Peacock Mining Co., Cal. Photo by courtesy of the company.



View of sluice showing cast steel-plate riffles, with water off, Peacock Mining Co., Orleans, Cal. Photo by courtesy of the company.

Gravel bank, Peacock Mining Co., Orleans, Cal. Photo by courtesy of company.

The deposit consists of gravel benches on the northwest bank of Klamath River at an elevation of 400 feet. The bedrock is schist and the wash of medium size with a few large boulders on bedrock. It runs up to 70 feet in depth.

The mine was formerly worked only on a small scale, and a great deal of preliminary work was required to permit enlarged operations. The company built a sawmill, constructed a dam on Camp Creek and built four miles of 5′ x 3′ flume capable of delivering 3000 inches of water to the penstock under 150-foot head. A deep bedrock cut was made for the upper end of the sluice. The sluice is substantially built, having a cross-section 36″ x 42″ in depth and is approximately $\frac{4}{10}$ of a mile in length. The lower 600 feet of the sluice has a grade of seven inches in 12 feet. The riffles are of 56-lb. rail, spaced on 5-inch centers, 380 feet of rail being required for this section. The upper end has a grade of five inches in 12 feet and the bottom is lined with $\frac{5}{8}$″ thick steel plates, 34½″ x 36″ in size, with a 3-inch riffle opening between the plates. The construction of this section differs from the usual practice, and is shown on the accompanying sketch. A 22-inch and a 15-inch pipe line delivers the water under 150-foot head to one No. 5 and one No. 3 Hendy giants. The water supply is adequate for a run of ten months annually under full head.

Piping of gravel was begun in March, 1925. The mine is being operated 24 hours per day, and an average of 2100 yards of gravel is handled daily. The gold averages $17.75 fine. Fifteen men are employed.

Bibl: State Mineralogist's Report XIV, p. 406.

Pearch Mine. This property, owned by P. L. Young, of Orleans, is located in Sec. 32, T. 11 N., R. 6 E., on Klamath River, about one mile northeast of Orleans. It was located about 50 years ago. Much gravel remains to be worked. It has been idle or worked only a little in the winter season in recent years.

Bibl: State Mineralogist's Report XIV, p. 404.

Red Porphyry Mine. Property consists of 90 acres in the Willow Creek district, in Sec. 17, T. 7 N., R. 5 E., two miles north of Willow Creek on the west bank of the Trinity River. Idle.

Bibl: State Mineralogist's Report XIV, p. 404.

Rocky Point Mine. Property consists of 60 acres covering bench gravels in Sec. 21, T. 11 N., R. 6 E., in the Orleans district. Elevation 500 feet. Wm. Wittmore, owner. Idle.

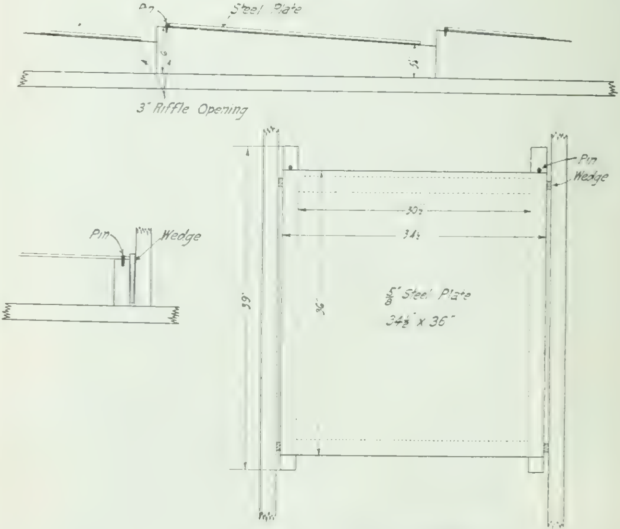
Bibl: State Mineralogist's Report XIV, p. 405.

Rosalina Placer Mine. Consists of two claims in T. 11 N., R. 6 E., on the northwest bank of the Klamath River, about eight miles from Orleans. There are two gravel benches both having slate bedrock. Water is brought in by ¼ mile of flume and delivered under 400-foot pressure. The mine has been worked each winter for many years and operations are still continued for about three months each year. Owner, Lew Nelson, Orleans.

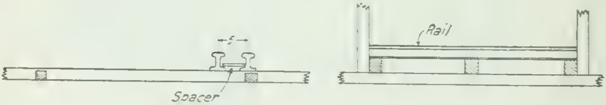
Bibl: State Mineralogist's Report XIV, p. 405.

CONSTRUCTION OF SLUICE AND RIFFLES

PEACOCK MINING CO.



Sketch Showing
Construction of Steel Plate Riffles



Sketch of
Section showing Rail Riffles

Rough and Ready Placer Mine (formerly Rough and Ready and Sarvorum placer groups). Property includes 120 acres, a part of the Wilder Ranch owned by A. R. Wilder et al. This mine is located in Secs. 1, 2, 11 and 12, T. 10 N., R. 5 E., in the Orleans district, three miles southwest of Orleans. The deposit consists of bench gravel at an altitude of 500 feet. Water for working was formerly brought in by 4¾ miles of ditch and flume. The flume was destroyed by fire several years ago, since which time there has been no water available for operations and the mine has been idle except for assessment work.

Bibl: State Mineralogist's Report XIV, p. 405.

Salstrom Placer Mine. (See Peacock Mining Co.)

Spanish Bar. One claim of 20 acres on a low bar of the Klamath River in Secs. 17 and 20, T. 10 N., R. 5 E. It is worked on a small scale during periods of low water by the owner, W. A. Taylor, Weitchpec, California.

Thompson Bar. Property consists of four claims about half-way between Weitchpec and Orleans, on the northwest bank of the Klamath, in Sec. 20, T. 10 N., R. 5 E. Water is obtained from Cap Creek, under 200-foot head, by 2½ miles of ditch and flume. The claims were located in 1907 by Wm. M. Salsbury. Now owned by Young Brothers of Weitchpec, who work it on a small scale.

Bibl: State Mineralogist's Report XIV, p. 406.

Weitchpec Bar Mine. This is a portion of the J. C. Gist holdings, located in the Weitchpec district in Sec. 10, T. 9 N., R. 4 E. It has not been worked much in recent years.

Bibl: State Mineralogist's Report XIV, p. 407.

Bibl. (Gold Placer Mines): State Mineralogist's Reports, VIII, pp. 216–223; X, pp. 205–208; XI, pp. 227–232; XII, pp. 132–135; XIII, pp. 172–179; XIV, pp. 401–407. State Min. Bur. Bull. 85; Bull. 92.

GRAPHITE.

Impure graphite occurs on the South Fork of Trinity River, also in T. 10 N., R. 4 E., and a little has been found near Eureka. No development work has been done. The deposits are of doubtful value.

IRON.

Both hematite, the most common iron ore, and magnetite occur in Humboldt County. The former occurs massive in veins, and as soft red ocher deposits. Magnetite is one of the principal constituents of the black sands. These deposits remain practically in the same condition as when first described in previous reports of the State Mineralogist. Data concerning them are briefly summarized herein.

Centerville Deposit. At a point on the coast, four miles south of Centerville, veins of hematite occur in metamorphic sandstone. A vein, eight feet in width, was exposed here years ago. This vein contained numerous thin seams of calcite, which made up about one-fourth its mass. It strikes east and dips 85° N. The ore is soft, of brownish-red color and tends to scale off like micaceous iron. A mile north of here a vein of possibly better grade was indicated by boulders of hematite that showed no visible calcite, found on the shore. Large masses of float found between these two localities at the mouth of a little gulch gave evidence of a third vein in that vicinity. The latter two do not outcrop. Some of this ore was ground and used locally as a mineral paint in the past.

Preston Property. One of the most accessible showings is that found on property owned by W. A. Preston, Box 387, Arcata. This holding comprises 160 acres of patented land, the NE¼ of Sec. 28, T. 6 N., R. 1 E., adjoining the townsite of Arcata. The ridges crossing the property are covered with a deep layer of soil and a heavy growth of redwood, fir, alder and brush, so that it is difficult to determine the character of the formations. Apparently they are highly metamorphosed siliceous sandstones and shales, with much jasper. A laminated vein of fairly hard red hematite dipping to the east at about 65°, is exposed in a short tunnel and shallow inclined shaft, the latter partly caved. There are a number of other pits on this and the opposite side of the ridge that shows the ore to exist in an area of 60 acres, but the work so far done is too superficial to permit any estimate of the real size of the deposit. Selected samples of the ore are reported to have contained 52% iron. In one cut a small lens of low-grade manganese ore, assaying 23% manganese, was uncovered. Good clay is also found on this quarter-section. The elevation at the Preston iron deposit is 200 feet. It is only two miles from tide water and ¾ of a mile from the railroad, and probably ranks as one of the best of the few iron deposits in the county.

Other occurrences noted are massive red hematite on Rainbow Ridge and small amounts of specular hematite near Orleans.

Bibl: State Mineralogist's Report XII, p. 326; State Min. Bur. Bull. 91, p. 101.

LIMESTONE.

Humboldt County is well supplied with limestone, but litle attention has been paid to its development.

The deposits most accessible to Humboldt Bay are on Jacoby Creek, in Secs. 13 and 14, T. 5 N., R. 1 E., and Sec. 19, T. 5 N., R. 2 E. A test by Smith, Emery and Company, of San Francisco, on cement made from croppings at this locality showed it to have a tensile strength of 554 pounds developed at seven days, 778 pounds at 14 days, and 901 pounds at 28 days.

An analysis of limestone from an adjacent deposit on Jacoby Creek gave the following result:[1]

SiO_2	1.41%
Lime, CaO 53.61%; $CaCO_3$	95.74%
Fe_2O_3	.35%
Al_2O_3	.56%
MgO	Trace
Water	.01%
Residue and carbonaceous matter	.50%
	98.57%
Volatile, CO_2, H_2O, etc.	42.40%

---

[1] State Mineralogist's Report XIV, p. 394.

A large dike of limestone crosses in a northwesterly direction from Trinity County to Humboldt in T. 4 N., R. 5 E. It extends northwesterly, passing east of Horse Mountain and cutting across Willow Creek. Undeveloped deposits of good size are also found in the southeastern section of the county.

Bibl: State Mineralogist's Reports, IV, p. 109; VI, pp. 23, 98; VIII, p. 216; XIV, pp. 374, 393–394.

MAGNESITE.

Magnesite is an important structural material of quite common occurrence in the serpentine belts of the Coast Range. It has been found in commercial quantities in several counties north of San Francisco Bay but was not known to occur in Humboldt County until recently.

Willow Creek Deposit. During the construction of the new road between Willow Creek and Hoopa the attention of highway engineers was attracted to small veins exposed in a cut. Samples were taken and the material proved to be magnesite. The deposit is of interest, but not believed to be of economic importance.

MANGANESE.

Manganese was one of the 'war minerals' and intensive search for deposits of manganese ores during the war period resulted in the development of a number of deposits in Humboldt County. There was a fair production of commercial ore in 1918 and again in 1920. Operations are handicapped in most cases by long hauls over mountain roads.

Porter Ranch Deposit. This deposit is in the east central part of the county in T. 3 N., R. 4 E., about 30 miles by road east of Carlotta, a station on the Northwestern Pacific Railroad. Extensive beds of Franciscan jasper occur here, in which manganese oxides, mainly pyrolusite, are found. The ore is high grade carrying about 50% metallic manganese and 9% silica. It was under lease to L. M. Bryant in 1918.

Bibl: State Min. Bur. Bull. 76, pp. 33–34.

Woods Prospect. This deposit is in Sec. 3, T. 1 S., R. 4 E., 12 miles northwest of Blocksburg. The property is owned by Wilson Woods, of Harris, Humboldt County.

Haw Claim. W. H. Haw has recently located the Apex claim in Sec. 3, T. 1 S., R. 4 E., H. M., for manganese.

Herbert Robbins, 3790 Piedmont Avenue, Oakland, California, is the owner of a deposit of manganese reported to be large and high-grade. It is 15 miles from the railroad. Its exact location was not learned.

As noted under the heading 'Iron,' a small lens of manganese ore was exposed on the property of *W. A. Preston*, but its commercial value has not been determined.

Bibl: State Min. Bur. Bull. 76, pp. 33–34.

MINERAL WATER.

Mineral water has been produced commercially in Humboldt County for many years, although the number of mineral springs is not great. The following springs have been described by Waring.[1] With the exception of Iaqua Medicinal Spring, they were not visited by the writer.

Cook Spring. This spring is 35 miles southeast of Eureka on the north bank of North Yager Creek, near the point where the road crosses the stream. The water contains sulphur and iron. It is not improved.

Felts Spring. Situated 5½ miles northeast of Fortuna, in T. 3 N., R. 1 E. There are three springs in the group yielding saline and sulphurated water. A hotel and resort was at one time maintained here.

Humboldt Artesian Mineral Well. This well was situated within the boiler-room of Flannagan's lumber mill, about one mile south of Eureka. It was 6 inches in diameter and 175 feet deep. The water was formerly bottled and carbonated and used as a table water for many years. It is an alkaline saline water.

Iaqua Medicinal Spring. Situated on the waterfront at the foot of K Street, Eureka. The mineral water at one time bubbled from the mud flats of the bay, but it has been cemented up and is now pumped from a well 20 feet deep and shipped in barrels to San Francisco, where it is bottled and placed on the market. Owned by Chas. E. Knight, 830 Market Street, San Francisco.

Mountain View Springs. This spring is located at a small resort on Mad River, 28 miles southeast of Eureka. The water is strongly sulphurated.

Bibl: State Mineralogist's Report XIV, pp. 408–410; U. S. Geol. Survey Water Supply Paper 338.

NATURAL GAS.

A gas suitable for illuminating and fuel purposes flows from some of the wells in the oil district of the county. There are many instances where gas is escaping from oil seepages, but only in two cases is the gas in sufficient quantity to be useful for domestic purposes.

Frank Peters Gas Well. There are three springs on Frank Peters' land in the village of Capetown in Sec. 13, T. 1 N., R. 3 W. The gas is tanked and used in the house for lighting and fuel purposes.

Briceland Estate Gas Well. A gas well is located on this estate at the town of Briceland in Sec. 18, T. 4 S., R. 3 E. The well is 780 feet deep and has 7⅝-inch casing. The well is capped and the gas is drawn off by a 1-inch pipe for lighting the houses of the town of Briceland. No storage tank is used, consequently the pressure is rather low after a few hours' use.

---

[1] Waring, Gerald A., Springs of California, U. S. Geol. Survey Water Supply Paper, 338, 1915.

PETROLEUM.

For reasons mentioned in the Introduction, the present writer has not included the oil possibilities or development work in the Humboldt County oil field in this report.

The petroleum resources, so far as they have been investigated by the State Mining Bureau, are discussed in the publications given in the bibliography. Current oil field operations are reported in 'Summary of Operations, California Oil Fields,' issued monthly by the Department of Petroleum and Gas of the State Mining Bureau.

> Bibl: State Mineralogist's Reports, VII, pp. 195–200; VIII, p. 216; X, p. 207; XI, pp. 227–232; XIV, pp. 410–414. State Min. Bur. Bull. 19, pp. 161–166; Bull. 69, pp. 444–454; Bull. 89, pp. 40–43.

PLATINUM.

Platinum in small amounts is produced in the course of placer gold mining operations. The platinum resources of the county are described in detail by Logan.[1] The properties are noted herein under Gold (Placer Mines).

SILVER.

Gettysburg Silver Mining Co. A company by this name with office in Reno, Nevada, located three claims in the Sawtooth Range, four miles from Sulphur, a few years ago. A 20-foot shaft on the Litharge claim is said to have cut a 4-foot vein of ore averaging $35 per ton, most of the values being in silver, with a little gold. The vein was prospected for 1500 feet in length and showed a width of 4 to 10 feet. No recent information was obtained regarding this property.

STONE INDUSTRY.

Large quantities of stone are being used as rip-rap in jetty construction at the entrance to Humboldt Bay. The crushed rock and gravel output enters into highway construction. Most of the plants producing these materials are located on or near the job, and are of a temporary nature, operating only until the work under contract is completed. There is but one company operating permanent commercial rock-crushing plants.

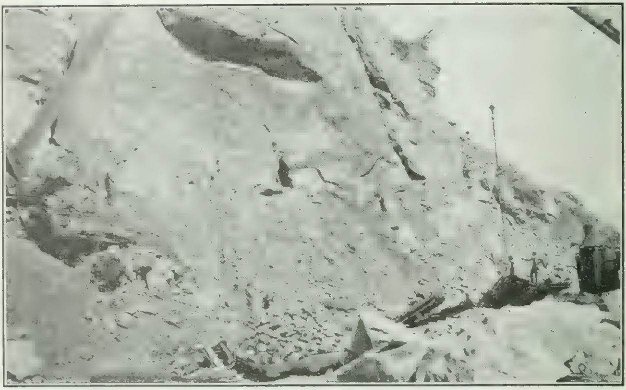
W. C. Elsemore, 432 W. Washington Street, Eureka, has a semi-portable rock-crushing plant at Freshwater, in Sec. 29, T 5 N., R. 1 E., five miles east of Eureka on the old Arcata road. It is operated intermittently in connection with his contracting business.

Engelhart Paving and Construction Co., office foot of S Street, Eureka. This company has operated a number of temporary crushed plants producing rock and gravel. Their plant on the highway at the point where it crosses Mad River, four miles north of Arcata, is now being dismantled.

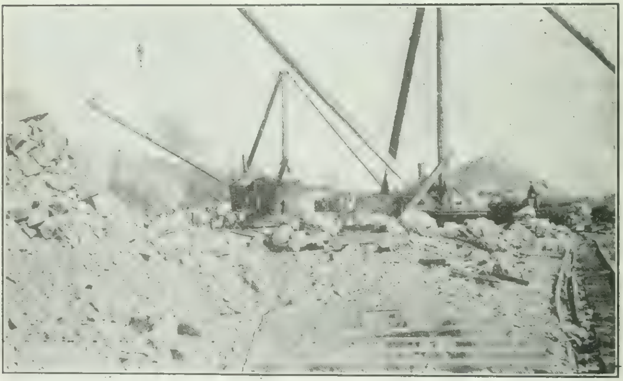
Haw Quarry. This quarry is situated six miles from Eureka at an elevation of 150 feet, in Sec. 21, T 5 N., R. 1 E. The rock is a basaltic

---

[1] Logan, C. A., Platinum and Allied Metals in California, State Min. Bur. Bull. 85.



Coyote tunnel in quarry face (center) Medicine Rock Quarry, Humboldt County.



Medicine Rock Quarry, Humboldt County.

lava. It was formerly operated on a large scale, supplying much of the rock used on jetty construction at Eureka. Now owned by the city of Eureka. Idle.

Bibl: State Mineralogist's Report XIV, p. 392.

A. N. Hunt Quarry. Property is situated four miles north of Arcata. The deposit consists of granite boulders which were formerly used to a small extent for monumental purposes. There has been no production for many years.

Isaac Minor Quarry. Property situated on Warren Creek, a tributary of Mad River, in T. 6 N., R. 1 E. A granitic rock was mined here, suitable for building purposes, but utilized mainly for government work on the harbor jetty and as road rock. Owned by I. N. Minor and L. C. Everding, address, I. N. Minor, Glendale, Humboldt County. The property is idle, but equipped and in shape to resume operations.

Bibl: State Mineralogist's Report XIV, p. 393.

Jacoby Creek Quarry. This quarry on Jacoby Creek, five miles from Arcata, was formerly worked on a large scale by contractors supplying fill for the harbor jetty. The rock is a metamorphic sandstone. All equipment has been removed, and it is idle.

Bibl: State Mineralogist's Report XIV, p. 392.

Medicine Rock Quarry. This quarry was opened up in June, 1924, to supply rip-rap for the jetty under construction at the entrance to Humboldt Bay, by A. D. Kern, 290 East Salmon Street, Fulton, Oregon (A. D. Kern Construction Company). The quarry is on the property of the Hammon Lumber Company, at the end of the Northwestern Pacific Railroad, ¾ of a mile southeast of Trinidad. The rock which outcrops prominently is a greenish-gray, somewhat altered diorite. A small part of the output is crushed and screened to a product of from 1″ to ¼″, and sold for use on the state highway. There are five complete steam-operated derricks and hoists using crude oil for fuel; one locomotive crane, one Climax oil-burning locomotive, and a compressor plant with two compressors, operated by a semi-Diesel engine for supplying air for drilling. At the time of visit a coyote tunnel was just completed in the face of the quarry, and was being prepared to receive a charge of 1000 kegs of powder. The blocks as placed weigh up to 20 tons each. The camp is large and complete, 115 men being employed. It is estimated that there is about three years' work ahead on this job.

Mercer Fraser Co. James D. Fraser, president: J. L. Brown, secretary. Home office, 109 G Street, Eureka, California. This company operates two plants, one on Mad River at Essex, and the other on Eel River at Warwick, near Fernbridge. The Essex plant is operated by steam power. A ¾-yard Sauerman drag-line scraper is used for elevating the gravel. The material is crushed, washed and screened to two sizes, 2½″ to ¼″ and ¼″ to dust. The plant has a capacity of 100 yards per day. It is operated by two men. The material is loaded direct to railroad cars or trucks. The Warwick plant is the larger of the two. It is operated by electric power and has a capacity of 200 yards per day. A 1½-cubic yard Sauerman drag-line scraper elevates the gravel to the plant where it is crushed, screened and washed. Three sizes are produced, 1½″ to ¾″, ¾″ to ¼″ and ¼″ to dust. Two men are required for operating. The material may be loaded on railroad cars or trucks.

VOLCANIC ASH.

Weatherby Ranch Deposit. On the property of the Hanify Lumber Company, under lease to Clarence Weatherby and adjoining the Weatherby Ranch four miles south of Elk River. A bed of fine, creamy-white volcanic ash, two feet in thickness, is found about half way to the top of a ridge running through the property. The strata are nearly horizontal and consist, so far as development has shown, of a capping of clay below which is the volcanic ash, then six feet of clay, two feet of lignite and another clay stratum of undetermined thickness. The deposit was opened up several years ago and the ash mined through a short adit run in on the bed. There has been no recent shipments. Its composition is given in the following analysis, by W. H. Gallagher, Eureka:

SiO_2	70.0%
Al_2O_3	18.5%
Fe_2O_3	0.6%
CaO	3.4%
MgO	0.5%
K_2O	2.4%
Na_2O	3.4%
Undetermined	1.2%
Total	100.0%

The clay and coal have not been exploited. The property is within ¼ mile of the Hanify Lumber Company's railroad.

LOS ANGELES FIELD DIVISION.

W. BURLING TUCKER, Mining Engineer.

SAN DIEGO COUNTY.

Introduction.

San Diego was discovered in September, 1542, by Juan Rodriguez Cabrillo. This discovery of the San Diego region by Cabrillo was followed by the establishment of the first Franciscan Mission in California on June 16, 1769, by Padre Junipero Serra. The location of this Mission at San Diego led to the early settlement of the Pacific Coast and is of special prominence in the early history of California.

The county was one of the original twenty-seven counties organized in 1851 by act of the state legislature. In 1889 its area was considerably reduced by the formation of what is now Riverside County, and was further diminished in 1907 by the organization of its eastern portion as Imperial County.

The principal industries are agriculture, stock raising, dairying, and commercial fisheries. The mining industry is relatively undeveloped, although the mineral resources of the county are varied and extensive. The rapid and continued growth of the city of San Diego, and the manufacturing industries on the Pacific Coast have led to the development of deposits of structural and industrial materials throughout the county.

Description.

San Diego is bounded on the east by Imperial County, north by Riverside and Orange counties, west by the Pacific Ocean, and south by Mexico. Its area is 4221 square miles and its population 112,248 (census of 1920).

The county and the city of San Diego are served by two railroads, the Santa Fe and the San Diego and Arizona. The Santa Fe Railroad enters the county at San Onofre and follows the coastline to San Diego, connecting the latter with the city of Los Angeles. From the main trunk line there is a branch line from Los Angeles Junction, known as the Fallbrook branch that runs as far as Fallbrook; another branch line runs from Oceanside to Escondido, giving railroad transportation to an important citrus belt. The San Diego and Arizona Railroad runs along the border of Mexico and the county, connecting San Diego with Imperial Valley at El Centro. The Cuyamaca branch of this line runs from San Diego to Lakeside, affording transportation for El Cajon Valley and other interior points. From the port of San Diego regular steamer lines ply between San Diego, Los Angeles, San Francisco, Seattle.

San Diego has a wonderful system of highways and good roads which give access to all parts of the county. Two main paved highways from Los Angeles to San Diego parallel the coast. The coast route follows the coast line and the inland route is via Riverside, Fallbrook, and Escondido to San Diego. Two paved highways connect Imperial Valley with San Diego. Five scenic highways, stretching out from San Diego like ribs of a huge fan with its northern tip at Oceanside and its southern tip at Campo within one mile of the Mexican border afford easy access by automobile to all parts of the San Diego mountains. Each one of these intersects the road, forming the outer rim of the fan which traverses practically the entire Incopah Range from northeast to southwest, a distance of more than 170 miles. The total mileage of all the fan-shaped routes is nearly 600 miles.

Physiography.

The topographic features of the county consist of a series of parallel ranges of granite, with a southeast trend, including the southeastern continuation of the San Jacinto Range of Riverside County. Among these granite ranges are valleys occupied by parallel belts of metamorphic rock, chiefly slate and mica schist, with some quartzite and lentils of limestone. These have a general northwest strike, with steep dips to the east, and extend from Mexico into Riverside and Orange counties. The Cuyamaca and Laguna Mountain ranges extend northwest and southeast, and are over 5000 feet high at many points. Cuyamaca Peak has an elevation of 6515 feet, and Laguna Mountain, an elevation of 6500 feet. These are intrusions of diorite and gabbro which occur at intervals in the granite area. Southwesterly from this elevated belt the altitudes decline toward the coast. West of the granite area is a belt of volcanic felsite and tuff, that extends northwest some 40 miles from the Mexican line. The belt is only a few miles wide, for the most part being buried beneath mesa formations. It is exposed at many points, forming the peaks of Otay, San Miguel, and Black Mountains. The mesas of Tertiary deposits which occur on the west flank of the crystalline formations gently slope seaward, from an altitude of about 500 feet at its eastern margin to an elevation of about 300 feet near the coast line. From the main divide the surface slopes steeply eastward toward the Salton Basin.

The principal valleys of the county are those occupied by the Santa Margarita, San Luis Rey, San Dieguito, San Diego, Sweetwater, Otay, and Tia Juana rivers. They are characterized by wide, flat, gently-sloping floors, bordered by steep slopes or bluffs several hundred feet high and they contain streams that rise far back in the mountain area. All these streams flow to the ocean. El Cajon Valley, Santa Maria Valley, and Warner Valley are comparatively flat tracts, some of them surrounded by steep mountain walls, and cover many square miles, within the highland area, and form the broad valleys.

Geology.

The geology of San Diego County has been described in detail by W. A. Goodyear in the Eighth Annual Report of the State Mineralogist, pp. 516–528, for the year 1888; by Harold W. Fairbanks in the Eleventh Report, pp. 76–120, for the year 1892; by Dr. F. J. H. Merrill in the Fourteenth Report of the State Mineralogist, pp. 637–645, for the years 1913 and 1914; in Water Supply Paper No. 446, U. S. Geological Survey, 'Geology and Ground Waters of the Western Part of San Diego County.' The reader is therefore referred to the above publications, in which the geology of the region has been covered in more detail than will be attempted by the present writer, as the principal purpose of this report is to present data pertaining to the minerals of the county so far as they have been investigated by the State Mining Bureau, in the hope that their development and utilization may be hastened.

The formations of San Diego County are granites and other igneous crystalline rocks of several ages, metamorphic strata of great age, possibly Carboniferous or older, and sandstones, shales, conglomerates, sands, gravel, and clays of Mesozoic and Tertiary age.

The granites upon which the metamorphic rocks rest, and by which they are intruded are of several types. These granites are in turn intruded here and there by basic rocks of the diorite and gabbro types. The latter are cut at many points by pegmatite dikes which also appear as intrusives in the schists and in the granites. Two areas of these basic intrusives form substantial mountain ranges, one traversing the Cuyamaca Grant from north to south, and forming three peaks, of which the southermost, 6515 feet high, is known as Mount Cuyamaca. Ten miles southeast is a diorite ridge, known as Laguna Mountain, of which the summit attains an altitude of over 6500 feet.

On the southwest flank of the granite area is a volcanic flow, a few miles wide, extending northwest some 40 miles from the Mexican boundary. This area is largely overlain by Tertiary formations. The principal rocks exposed are felsite, tuffs, and volcanic conglomerates. The metamorphic formations are mica schists, slates, quartzites, and limestone; the mica schists are well exposed at Julian and on the west flank of the Laguna range of mountains. The Cretaceous strata exposed in this region are of the Chico series and appear in the bluffs on Point Loma and at La Jolla as described by Harold W. Fairbanks in the Eleventh Report of the State Mineralogist, p. 95.

The earlier Tertiary or Eocene deposits appear at the surface from Los Peñasquitos Canyon northward to Buena Vista Creek; the later Tertiary deposits are exposed from Los Peñasquitos Canyon southward to the Mexican boundary, and from Buena Vista Creek northward to the north boundary of the county. The earlier Tertiary or Eocene beds are made up of white sandstone, underlain by alternating layers of shale, sandstone, and thin layers of clay and shale, limestone and sandstone, and marl and calcareous material.

Mineral Resources.

The last general report on the mines and mineral resources of San Diego County appeared in the Fourteenth Report of the State Mineralogist (1913–1914). The writer of the present article spent from May 18 to July 1, 1925, on a survey of the county in an endeavor to collect up-to-date information on all mining activities and mineral resources, with the exception of the clay deposits which were visited by Mr. W. F. Dietrich of Stanford University, who is compiling a report on the 'Clay Resources of California,' which will be published by the State Mining Bureau at a later date. Therefore, in this paper only a brief report will be attempted on the various deposits of clay throughout the county. Appreciation is here expressed for the courteous treatment and cooperation of operators, owners, and the Chambers of Commerce throughout the county. Acknowledgments are especially due to Mr. H. R. Jackson, Industrial Manager of the San Diego Chamber of Commerce; Mr. Claus Spreckels, of the San Diego Electric Railway Company; Mr. J. B. Current, of San Diego; John and Thomas Noble, of Descanso; L. E. Keger, of San Diego; M. C. Turner, of San Diego; J. W. Mykrantz, of Ramona; W. H. Knowles, of San Diego; P. J. Kane and C. W. Curry, of Julian, for their cooperation and for the valuable information which they furnished.

San Diego ranks twenty-fifth in the total value of its mineral output, and tied for second place with Los Angeles County in point of variety, with a record of 17 different commercial minerals for the year 1923. The value for 1923 amounted to $821,776, as compared with the 1922 output worth $656,807. In 1918, for the only time in several years, there was no production of gems, in which San Diego County has led the state. The minerals commercially produced are as follows: Brick, clay, feldspar, fuller's earth, gems, gold, granite, lithia, lead, magnesium chloride, marble, mineral water, molding sand, salt, silica, silver, and stone. Aside from the minerals commercially produced, San Diego contains occurrences of bismuth, graphite, marble, nickel, soapstone, tin, and tungsten (scheelite). Potash has been produced from kelp. A development of recent years is the shipping of pebbles for grinding mills. The attached table gives the complete recorded output and value of the mineral production of the county from the earliest available record for 1880 to and including 1923.

METALS.

ARSENIC.

Arsenic is found in a number of localities in San Diego County in the minerals arsenopyrite (FeAsS), and scorodite, an oxidization product of arsenopyrite. The principal occurrences noted were in the Black Mountain and in the Laguna districts. At the Black Mountain Mine, located southwest of Escondido, some development has been done, and an attempt made to make a commercial product by concentration. It is principally used for the preparation of insecticides for agricultural and horticultural purposes, and especially against the cotton boll weevil in the southern states.

Black Mountain Mine is located in Sec. 5, T. 14 S., R. 2 W., S. B. M., nine miles southwest of Escondido on the north slope of Black Mountain. Elevation 1000 feet. Holdings consist of four claims known as the Black Mountain Group, a total of 80 acres. Owners, *Black Mountain Arsenic Company;* Wilfred Buckland, president; Eugene Overton, secretary; F. C. Hopkins, manager. Offices, 1300 Stock Exchange Building, Los Angeles.

The ore occurs as arsenopyrite, in two parallel dikes of quartzite that cut the diorite, with a general northwest strike, and a dip to the northeast. These dikes are from 10 to 15 feet wide. The arsenopyrite associated with pyrite occurs in the form of lenses, and also is finely disseminated throughout the fractures and seams in the quartzite.

Development consists of a tunnel 30 feet in length, two shafts 40 feet deep, and a number of opencuts made along the outcrops of the quartzite dikes. The mine run of ore extracted from the tunnel is reported to average 5% arsenic, with from $2 to $5 in gold per ton. During 1924 a 20-ton concentration plant was installed, but milling operations were suspended in July, 1924, on account of lack of water.

Mine equipment consists of a 7½″ x 6″ Chicago pneumatic compressor, and air drills.

Mill: One 7″ x 9″ Blake crusher, 20-ton Herman ball mill, and a Universal Overstrom concentrator. The plant is driven by a 70-h.p. Holt tractor gas engine.

The concentrates produced are stated to carry 40% arsenic with gold values. Two men are employed on development work.

Arsenic also occurs as arsenopyrite in the quartz veins of the *Willhite Group* of claims, located on the west slope of the Laguna Range, about nine miles east of Descanso.

BERYLLIUM.

A number of varieties of beryllium minerals are to be found, but none have been found in commercial quantities except beryl, which is a silicate of beryllium and aluminum, carrying when pure 57% silica, 19% alumina, and 14% beryllium oxide. Beryl occurs in San Diego County in the pegmatite dikes of the tourmaline-gem district in the northern part of the county. Thus far no commercial shipments have been made except for gem purposes (the pink and aquamarine varieties). To be suitable for commercial purposes it should carry from 10% to 12% beryllium oxide.

After the ore is mined it is ground to pass 90–95% through a 200-mesh screen. It should be white in color, free from iron-bearing minerals and metallic iron. The price varies from 4¢ to 5¢ per pound in carload lots, according to demand and the percentage of beryllium oxide.

The chief use at present for ground beryl is as an addition to porcelain products, where it reduces the coefficient of expansion. Beryllium metal is difficult to separate from aluminum. For this reason the mineral phenacite (Be_2SiO_4) would be a more desirable source for the metal, as it carries approximately 45% beryllium oxide.

BISMUTH.

This metal has been found in small quantities associated with amblygonite in the lithia vein at Pala. It occurs both as native bismuth and as an oxide. Small samples of native bismuth have been reported from other points, especially near Jacumba. It is used in fusible alloys for electric fuses, for protecting boilers etc., in painting glass and porcelain, and in medicine.

COPPER.

Copper minerals occur in association with the ores of other metals quite extensively throughout the county, but no large deposits have as yet been developed. This metal has been found at several points in the hills between Escondido and Encinitas. Some of the claims near Escondido are being held by assessment work, but the old Encinitas Copper Mine has not been worked for a number of years.

On the San Vicente Grant copper minerals occur in a mineralized zone on the contact of granite and schist. Surface croppings show brown oxides of copper, malachite, and some azurite. Below the oxidized zone a sulphide zone was encountered, and chalcopyrite associated with pyrite is finely disseminated throughout the schist. This deposit was formerly known as the *Barona Mine*, and is now being worked by the *Southern California Mining and Smelting Company*, of San Diego. Chalcopyrite carrying gold has been found in small quantities on the east slope of Barber Mountain northeast of Dulzura. Southwest of Julian the *Friday Mine*, owned by the *Friday Copper Mining Company*, of San Diego, shows a small percentage of copper sulphides and carbonates along the gossan outcrop. The ore developed in the mine shows only a trace of copper. From surface indications, with the exception of the Daley Mine southwest of Ramona, it seems improbable that anyone of the deposits thus far known has sufficient magnitude to develop into a copper mine of much importance, though some may yield limited quantities of commercial ore.

Daley Copper Mine comprises 100 acres of patented land located in Sec. 11, T. 13 S., R. 1 E., S. B. M., seven miles southwest of Ramona. Elevation 1650 feet. Owner, Sarah M. Daley, of San Diego. Under option to the *Southern California Mining and Smelting Company;* George W. Lindsay, president; J. W. Ott, secretary; M. W. Tanner, superintendent, San Diego.

This deposit was discovered in 1894 and operated from 1915 to 1916, by the San Jacinto Mining and Milling Company. In 1916 it was bonded to the Southern California Mining and Smelting Company, of

San Diego, which operated the property until December, 1923, and then after a short shutdown resumed operations.

A mineralized zone about 150 feet in length by 50 feet in width occurs on a contact of granite and schist. Surface croppings show brown oxides of copper, malachite, and some azurite. The oxidized zone has a depth of 30 feet. Here the sulphide zone was encountered; the ore occurs as chalcopyrite associated with pyrite and is finely disseminated throughout the schist. It is stated that the ore mined will average from 2% to 3% copper, with 6 oz. silver. The mineralized schist is cut by a porphyry dike 12 to 15 feet wide, which strikes N. 50° E., with a dip of 70° NW.

Development consists of a vertical shaft 115 feet deep. A crosscut tunnel driven southeast 50 feet connects with the shaft 50 feet below the surface.

Mine equipment consists of a 12-h.p. gas engine hoist, 4½″ x 4½″ Rix compressor, cars, and air drills. The company is installing a 50-ton concentration plant. Fifteen men are employed.

Bibl: State Mining Bureau Bulletin No. 50, p. 345; State Mineralogist's Report XX, p. 370.

Encinitas Copper Mine is located in Sec. 28, T. 13 S., R. 3 W., S. B. M., eight miles east of Encinitas. The mine was formerly operated by the *Encinitas Copper Company*, of San Diego. Holdings comprise 20 claims, and the croppings on these claims show the presence of copper.

Development consists of two shafts 200 feet apart, and a tunnel. One shaft is reported to have a depth of 280 feet, the other 100 feet. These shafts were sunk on a vein three feet in width in a porphyry formation. The ore is chalcopyrite associated with pyrite. The property has been idle for years.

Bibl: State Mining Bureau Bulletin No. 50, p. 344.

GOLD.

Since publication of the Fourteenth Report of the State Mineralogist in 1914, there has been a revival of interest in gold mining throughout the county, the principal districts affected being Boulder Creek, Laguna, Deer Park, and Julian, where there has been considerable prospecting and some of the old properties are being reopened.

The principal gold belt extends southward a distance of 45 miles from the Montezuma district, east of Warner to the Mexican border. The most productive district has been the Julian-Banner district. This district is 55 miles northeast of San Diego by paved highway, and about 35 miles from Foster, the terminus of the San Diego and Arizona Railroad. A new road which connects with Imperial Valley has been built from Julian to Banner. This road will prove of great benefit to the mines located east of Julian.

History.

Gold has been known in this district since a very early period, and placers were worked in the neighboring gulches for some years before the precious metal was found in veins. The first vein discovery is said to have been made in 1869 on what was afterward the Van Wert claim. On February 22, 1870, another vein was discovered, and a claim located on it under the name of Washington. From 1870 to 1880 there was great activity in this district, and the production of gold is estimated at over $2,500,000.

General Geology.

The country rock is a metamorphic slate or mica schist with a northwesterly strike and a nearly vertical dip. At some points it has been injected with granitic material in thin sheets parallel to the foliation of the schist. When this occurs a rock results which closely resembles a granitic gneiss. Small intrusive areas of granite also appear. The mineralization of this area is in fissure veins of quartz, which, both in dip and strike, are generally parallel to the schistosity of the country rock. These veins are essentially 'stringer leads' and are usually small in width, following the curving strike of the schists as these swing westward toward Julian.

Several parallel veins have been recognized, four of which have been regarded as continuous for several miles. The farthest east is known as the Chariot vein; those succeeding westward being known as the Ready Relief, Cable and Ruby.

In the Boulder Creek district the auriferous quartz veins are in a narrow belt of mica schist and granite. In the Descanso and Deer Park districts the quartz veins are in the granite.

The Laguna district is on the west slope of the Laguna range of mountains. Here the quartz veins are in a belt of micaceous schist one mile in width, which has a general northwest strike, and is about two miles in length along the course of the belt.

Some activity in placer mining is shown on Coleman and Banner creeks. In the former the gravels are being worked in a small way, and it is stated that the operators are making fair wages. On Banner Creek a number of drill holes have been put down by John L. Hall, on the San Felipe Ranch. It is stated that samples taken from the various test holes ran from 30 cents to $1.50 per yard.

F. C. Hopkins and associates of Escondido have done considerable prospecting along the old river channel known as the Ballena Placer in Sec. 17, T. 13 S., R. 2 E., and also on the San Vicente Grant, southeast of Ramona. The gravel is said to carry from 30 cents to $1.50 per yard. A screening and washing plant having a capacity of fifty tons has been installed.

Mines.

Ballena Placer. This deposit of auriferous gravel, located southeast and east of Ramona, is an old river bed with a southwesterly trend, belonging to a system of drainage now extinct and possibly of Tertiary age. The gold may have come from the region about Julian. As described by Fairbanks:[1]

> "It is not generally known that an ancient auriferous gravel channel exists in the county. It begins about a mile north of the old stage station, and three miles west of Ballena Post Office where there rises a hill shaped like a whale's back (hence the name Ballena), covered with washed gravel and boulders. The main portion of the channel which has escaped erosion begins south of the stage station, capping a hill which has an elevation above the sea of 2400 feet, being a little lower than the so-called Whale Mountain. The gravel is 50 to 100 feet thick, and has a width of

---

[1] Fairbanks, H. W., Geology of San Diego County: State Mineralogist's Report XI, pp. 91–92, 1892.

2000 feet or more. It rises 300 to 500 feet above the valleys and canyons on its sides. It extends in a direction a little south of west for about four miles, terminating on the south of Santa Maria Valley. A granite ridge runs two or three miles farther in the same direction, probably preserved by the gravels, which are now gone. A pretty valley, a mile long, has been eroded in the eastern end of the gravels, down to the underlying granite. Placer mining has been carried on for years here in a small way by Mexicans. Gold is said to be scattered everywhere through the gravels, which are often very firmly cemented. Lack of water, for the ridge is higher than any of the surrounding country, has prevented work on a large scale. * * * In the gravels are washed boulders, many of them two feet in diameter and well polished. The remarkable thing about them, however, is that they are nearly all porphyries. The most abundant is a red feldspar-quartz porphyry. Quartzite boulders of all colors are numerous, and there are a few of the basic diorite so common in portions of the county. Garnets are said to be very abundant in the gravels, and many boulders of a schist carrying them are present. The matrix of this rock could not be made out in the field; it is very tough and heavy, and has never been seen in place. The red porphyry boulders resemble those on the mesa farther west, but have never been found in place. Never, in the mountains east or north, has porphyry of this kind been seen, either by myself or described by others. From the old stage station the upper course of the stream was north and south as far as it can be traced. There are indications that one branch extended easterly toward Julian. These gravels appear on a hill surrounded by deep canyons, about two miles east of the top of the grade above Foster's. At the top of the grade the hills on the west are flat-topped, and covered with gravels to a depth of 150 feet. These have much the same character, and probably belong to the same channel. More investigation is needed to determine whether the course of the old stream was down toward the San Diego River, in Cajon Valley, or west toward the high mesas south and southeast of Poway Valley. It seems probable, however, that the stream flowed west, and that the mesas have been formed partly from the boulders which they brought down. This mesa, as well as the gravels at the head of the grade, has an elevation of 1500 feet. The source of the porphyry boulders and the garnetiferous schists of this old river is a matter of great perplexity. The gravel deposit has every characteristic of an old river channel, and not that of an elevated arm of the sea; besides, the presence of gold in the gravels indicates their derivation from the country farther east. The gold may have been derived from Julian or Mesa Grande, or some other remote point. The river must have flowed across the gold belt, but then the question arises, how could a river of such magnitude have existed so near the summit? The only way out of the difficulty is to suppose that a great uplift has taken place along the crest and western slope, coupled with an enormous amount of erosion; and that this stream once, before this great change took place in the configuration of the country, headed many miles to the northeast, far beyond the drainage of the western slope. The boulders consist largely of hard rocks, and are very smoothly rounded and polished, indicating that they have been transported a long distance, and subjected to attrition through a protracted interval."

The most productive area is located in parts of Secs. 17, 18, 19, 20, and 21, T. 13 S., R. 2 E., S. B. M. This ground, comprising 600 acres, is owned by John Johnson, of Escondido. Pay gravel also occurs in Sec. 16, on the F. R. Sawday Ranch, and extends south into the San Vicente Grant, owned by J. W. Mykrantz, of Ramona.

The gold occurring in the gulches on the San Vicente Grant has evidently been distributed by erosion from the channel exposed on the range of mountains that lies between San Vicente Valley and Santa Maria Valley.

F. C. Hopkins Placer Mining Company, of Escondido, has a lease and bond on the 600 acres owned by John Johnson.

The present operations are being carried on in Granite Creek, at the point where Mr. C. F. Willard, of Ramona, started operations in 1906, and operated off and on until 1914.

The width of the channel at this point is about three-fourths of a mile, and it is said to have an average thickness of 30 feet, with values averaging 30 cents per yard, while richer streaks and channels carry as high as $1.50 per yard. The gold is fine and occurs all through the gravel from the surface to bedrock and does not appear to be any richer at bedrock than in the upper gravel. Mr. F. C. Hopkins expects to have the washing plant under operation during the month of July, all depending on the development of water in the bed of Granite Creek.

The plant for treatment of the gravel consists of a 4′ x 16′ revolving screen, where the gravel is screened to ¼-inch size; oversize gravel is rejected. From this screen the finer dirt passes to a revolving drum containing riffles, which is set over a large tank containing over 2000 gallons of water. In this tank agitators mounted on endless chains dissolve the dirt and carry out the pebbles and the coarse sand, leaving the finer sediment carrying the gold to settle at the bottom of the tank.

The screens are operated by two gasoline engines. A gasoline-driven P. & H. shovel delivers the gravel from the channel to the plant. The screening and washing plant is so constructed that it can be moved along the channel by means of a tractor. Pannings taken along the channel by the writer show the presence of five to ten colors of gold to the pan. The gold is quite fine, but very bright. Mr. Hopkins has sunk numerous prospect holes and trenches along the channel on Granite Creek, and also on the San Vicente Ranch, and the results of these test holes warrant the exploration of these gold-bearing gravels. It will be interesting to learn of the final results after the plant is under operation. The main difficulty will be due to lack of water. Six men are employed.

Boulder Creek Mines comprise ten claims located on the south slope of Mineral Range and north of Boulder Creek, in Secs. 9 and 10, T. 14 S., R. 3 E., S. B. M., 14 miles southwest of Julian. Elevation 2500 feet. Owner, *Boulder Creek Consolidated Gold Mining and Milling Company;* Thomas J. Fisher, president; George Mayer, vice president; J. H. Kleine, secretary, Lakeside.

The vein occurs in a narrow belt of schist in the granite. The vein strikes N. 30° W., dips 80° W., and has an average width of three feet. The ore shoots are short being from 20 to 30 feet in length. Average value of the ore is said to be $6 to $12 per ton. The quartz shows free gold associated with pyrite and arsenopyrite.

The properties are developed by 2000 feet of tunnels and drifts. The lower tunnel is driven as a crosscut 80 feet north to the vein, and a drift run 160 feet N. 30° W. on the vein. At the intersection of the crosscut and the drift a winze has been sunk on the vein to a depth of 30 feet. Here the vein has a width of three feet, and is said to average $7 in gold per ton. At 50 feet above this tunnel, another tunnel has been driven on the vein 360 feet. Sixty feet above No. 2, a third tunnel has been driven N. 30° W. 150 feet on the vein.

The ore shoots developed in these workings are about 50 feet apart along the strike of the vein, but are short, being only about 20 feet in length. Ore shoots have been stoped to the surface above No. 2 and No. 3 tunnels. It is said that the ore mined plated $14 per ton in gold with a loss of $5 per ton in tailings.

Mill equipment consists of 6″ x 9″ Blake crusher and Lane mill driven by a 20-h.p. gas engine. Two men are employed.

The *Brown Group* of claims comprises four claims known as Santen, Trixie, Lottie, and Laura, located in Sec. 9, T. 15 S., R. 5 E., S. B. M., in the Laguna range of mountains, nine miles east of Descanso.

These claims lie west of the Frances group. Two parallel veins occur in the schist near the west contact of the granite. The veins strike N. 30° W., and dip 50° to 60° NE. They have a width of from 4 to 8 feet.

Development work consists of prospect holes and opencuts made at intervals along the outcrop of veins. J. J. Brown, of San Diego, owner.

Cleveland-Pacific Mine (*Escondido Mine*). The property is located two miles southeast of Escondido in Lots 2 and 4 of Block 257, and Lot 4 of Block 188. This mine is on the Rincon del Diablo Grant, purchased in 1884 by the Escondido Town and Land Company. The property was operated by early Spaniards or Mexicans. About 1868 it was worked by Americans with an arastra. In 1897 it was taken over and operated by the *Cleveland-Pacific Mining Company* until 1911. The reported production of the mine is about $250,000. In 1924 B. F. Brough and associates, of Toledo, Ohio, secured an option on 120 acres.

The vein which is said to vary in width from a few inches to three feet, occurs in granodiorite with a strike of N. 40° E., and dip about 40° westerly. The Cleveland-Pacific Mining Company sunk an incline shaft on the vein to a depth of 350 feet. The drifts on the vein from this shaft amounted to 500 feet.

The present operators have sunk a two-compartment vertical shaft about 500 feet southwest of the old shaft to a depth of 160 feet. At a depth of 150 feet a crosscut was driven to the vein, and it is reported that 450 feet of drifts were run to the northeast. The vein cut on this level is said to be six feet in width, and is made up of quartz and talc. The ore is said to assay from $7 to $50 per ton, the quartz being heavily mineralized with pyrite.

Equipment consists of a 25-h.p. electric hoist, Sullivan compressor driven by a 30-h.p. motor. Eight men are employed. J. W. McLeod, superintendent.

> Bibl: State Mineralogist's Reports, VIII, pp. 524–525; XI, p. 382; XII, p. 240; XIII, p. 336; XIV, p. 650.

Descanso Mine (*Ellis Mine*) comprises 17 claims located in Sec. 24, T. 15 S., R. 3 E., near the town of Descanso. Elevation 3500 feet. Owner, Mrs. A. B. E. Shute, of Descanso.

A series of parallel veins of quartz occur in the granite, the general course being east. Practically all the development work has been confined to the Magdalena vein, which dips 80° N. An incline shaft has been sunk on the vein to a depth of 230 feet. The vein developed varies in width from 12 inches to 3 feet. The quartz shows a small percentage of free gold associated with pyrite, marcasite, galena, and pyrrhotite. The vein has been drifted on 80 feet west on three levels above the 200-foot level. The ore developed is said to assay from $10 to $50 per ton in gold.

Equipment: A 15-h.p. gas engine hoist, 8″ x 8″ Fairbanks-Morse compressor driven by a 25-h.p. Western gas engine, blacksmith shop, cars, air drills, and a Cameron pump. Two men are employed.

Eagle Mine comprises one claim located one mile east of Julian in Sec. 5, T. 13 S., R. 4 E., S. B. M., Julian mining district. Elevation 4200 feet. Owner, A. P. Frary, of Julian. Under lease to G. Dodge, of Julian.

Two parallel veins occur in the schist, and have a general northwest strike, with a dip of 60° to the east. These veins have an average width of 12 inches.

Development consists of two tunnels and a shaft 100 feet deep. The lower tunnel is a crosscut driven N. 10° E. for 300 feet. At 50 feet from the portal the first vein is cut, which was drifted on 75 feet northwest, and 50 feet southeast, and stoped to the surface. The second vein was intersected at 120 feet north, with a drift on the vein 150 feet to the northwest. This vein was also stoped to the surface. About 200 feet west of this tunnel, at a higher elevation, a tunnel has been driven N. 40° W. on the first vein, a distance of 300 feet. Several winzes and raises have been made on the vein which is 8 to 12 inches wide. The ore mined is said to have an average value of $25 per ton in gold. A two-stamp mill is being installed. Two men are employed.

Bibl: State Mineralogist's Report XIII, p. 335.

Elk and Landslide Claims are located in Sec. 3, T. 14 S., R. 3 E., S. B. M., on Kelly Creek, a tributary of Boulder Creek, one mile southwest of Anahuac Ranch, and 12 miles south of Julian. Owners, R. D. and B. F. Moore, of Julian.

The Elk vein is six feet wide, and strikes N. 20° W. Quartz shows free gold associated with pyrite and arsenopyrite. Landslide vein has an east and west course, and a width of 12 inches to 2 feet. Both veins are in granite.

Development consists of a number of prospect holes along the outcrops.

Ester Group of claims is located in the Laguna mining district, about 10 miles east of Descanso, and north of the Melba group of mines. The group comprises three claims. Owner, James Fox, Guatay. The veins occur in schist, and strike N. 20° W. Prospect.

Expansion Group of claims is located in Sec. 31, T. 14 S., R. 5 E., S. B. M., in Harper Canyon, in the Deer Park mining district, about nine miles northeast of Descanso. The group comprises four claims. A series of parallel veins occur in the granite with a general northwest strike. Prospect. Only shallow workings along outcrops of the veins.

Frances Group of claims is located on the west slope of the Laguna range of mountains, in the Laguna mining district. The group comprises the Frances, Ruth, Anna, Kitty, Nellie, and Nora claims, in Sec. 9, T. 15 S., R. 5 E., S. B. M., and are the south extension of the Melba group of claims. Owners, J. B. Current, Randcliff Haniman and associates, of San Diego. Elevation 5500 feet.

A number of parallel veins with a general strike of N. 20° W., and a dip to the northeast, occur in the schist. These veins have widths of from 8 to 10 feet, and their outcrops are prominent, being heavily stained with iron oxide.

The workings are on the ridge west of Noble Canyon Creek, and consist of a number of short tunnels and prospect holes. This group of claims is under option to J. M. Schurman and E. E. Northrop of San Diego, who propose to drive a crosscut tunnel to intersect the veins. Two men are employed.

Free Coinage Mine comprises two claims known as Free Coinage No. 1 and No. 2, in Sec. 12, T. 15 S., R. 4 E., S. B. M., in the Deer Park mining district, about eight miles east of Descanso. These claims are on the west slope of the Laguna range of mountains, near the headwaters of Indian Creek. Owner, Edward Quayle, of San Diego.

The vein occurs in the granite, and strikes N. 30° W. with a steep dip to the northeast. Width of vein is 12 to 18 inches.

Development consists of a vertical shaft 96 feet in depth, with a crosscut east to the vein. From the opencut along the outcrop south of the shaft, it is stated that 100 tons of ore milled at Noble Bros. mill, plated $18 per ton in gold.

Equipment: A 9-h.p. Fairbanks-Morse gas engine hoist, $4\frac{3}{4}'' \times 4\frac{3}{4}''$ Clayton air compressor, and pump. Idle.

Gold Crown Group of claims comprises five claims located in Secs. 1 and 12, T. 14 S., R. 3 E., S. B. M., in the Boulder Creek mining district, two miles southeast of Anahuac Ranch and 12 miles south of Julian. Owners, R. D. and B. F. Moore, of Julian.

The workings are on the ridge north of Boulder Creek. Here a tunnel has been run 70 feet east to cut a quartzite dike that strikes north. The dike has a width of 12 feet, and is mineralized with pyrite, marcasite, and arsenopyrite, with values in gold of $2 per ton. The formation is granite. Prospect.

Gold Standard and North Star Mines are situated in the Deer Park mining district, in Sec. 12, T. 15 S., R. 4 E., six miles northeast of Descanso. Elevation 5200 feet. The Gold Standard group comprises six claims; the North Star group has four claims. Owner, J. F. Gage, of San Diego.

Two parallel veins of quartz occur in the granite on the Gold Standard group. These veins have a general northerly course, and dip 45° W. The east vein has an average width of 4 feet. The North Star vein dips 35° W. and varies in width from 4 to 8 inches. The principal development work has been confined to the North Star vein and the east vein on the Gold Standard claims. The quartz contains free gold associated with pyrite and marcasite. Development on the Gold Standard group consists of two tunnels, the upper tunnel being driven 150 feet north on the vein; the other tunnel 50 feet below is driven north 190 feet. On the North Star vein an incline shaft has been sunk to a depth of 50 feet, and a crosscut tunnel has been driven 190 feet east to cut this vein.

Mine equipment consists of $4\frac{1}{2}'' \times 4\frac{1}{2}''$ Rix compressor, air drills, ore cars, and a blacksmith shop.

Mill: Twenty-ton ore bin, 20-ton ball mill, amalgamation plates and Cottrell concentrator driven by a 20-h.p. White gas engine. Idle.

Golden Chariot Mine is located in Sec. 14, T. 13 S., R. 4 E., four miles southeast of Banner, in the Julian mining district. Claims: Golden Chariot (patented), Golden Chariot North (patent applied for), Mascot, Ida Claire, and Gold Reef. Elevation 3500 feet. Miss Adelaide Elliot, of San Francisco, owns the Chariot and Chariot North; the other claims are held by location by the operating company. Under lease and bond to the *Golden Chariot Mining Corporation*, 410–412 Mercantile Bank Building, Berkeley, California; C. A. Ferrin, president; P. Young, secretary.

The property was discovered in 1871; worked from 1871 to 1886 producing $700,000; worked from 1913 to 1914 by the Chariot Mining and Milling Company, of San Francisco. The present company commenced operations in March, 1923, and development work on the property has been active to date.

The Chariot vein occurs on a contact of mica-schist and gneissoid granite, the former being the footwall and the latter the hanging wall. The vein is from 2 to 4 feet wide, strikes N. 20° W., and dips 65° NE. The vein is faulted east by a series of step faults. The ore occurs in lenses of quartz on the contact; ore shoots so far developed are short. The quartz is free milling, containing a small percentage of pyrite and tellurium.

Developments: Three shafts have been sunk on the vein; No. 1 shaft is 200 feet deep, No. 2 is 300 feet, and No. 3 is 250 feet deep. No. 1 shaft, the main working shaft, has been sunk on an incline of 65° and is on the vein to the 100-foot level. At this point the contact flattens to 45°. From the 100-foot level to the 185-foot level the shaft is in the footwall. On the 100-foot level the vein was drifted on south 200 feet. On the 185-foot level a drift was driven 150 feet south from the shaft in the slate footwall; then a crosscut 100 feet east to the contact; then run 130 feet south, connecting with No. 2 (Whitney) shaft, and continuing south 150 feet in ore from the No. 2 shaft to the face of the drift. On the 250-foot level from the Whitney shaft a drift has been driven south 220 feet, and north 60 feet. The No. 3 shaft was sunk to a depth of 250 feet and 125 feet on the vein, the remaining distance in the footwall, then a crosscut was driven east 60 feet to the contact. The ore shoot developed on the 250-foot level is about 200 feet long, has an average width of 4 feet, and is said to have an average value of $30 per ton in gold. The most productive ore shoot in the mine was from No. 2 shaft. The lens of ore worked out is said to have been about 65 feet in length by 185 feet deep, and 4 feet in width.

Five-Stamp Mill, at Golden Chariot Mine, Julian District, San Diego County.

Mine equipment: Fifteen-horsepower Foos gas engine hoist (14″ x 12″) (9″ x 12″) Imperial Type, Ingersoll-Rand compressor driven by

75-h.p. Holt gas engine, Ingersoll-Rand drill sharpener, blacksmith shop, and dwellings.

Mill: Blake crusher, Challenge ore feeder, five 850-lb. stamps, amalgamation plates, Wilfley concentrator. Slimes from this concentrator pass over 3 sand tables, each being 12 feet long by 5 feet wide. The mill is driven by 40-h.p. Western gas engine. A 10-kilowatt generator furnishes lights for the mine and mill, and also operates the 3-h.p. motor which runs a 5-inch Bulldose Meyers pump to lift water from the canyon to the tank above the mill. The company is planning to install five more stamps. Fifteen men are employed.

Bibl: State Mineralogist's Reports, VI, p. 86; IX, p. 147; XIII, p. 337; XIV, p. 658; XX, p. 372.

Good Luck Mine comprises one claim located in the Deer Park mining district in Sec. 31, T. 14 S., R. 5 E., S. B. M., about eight miles northeast of Descanso.

The workings are on a ridge east of Deer Park. A vein of quartz four feet wide occurs in the schist. Its strike is N. 30° E., with a dip 50° SE. An incline shaft has been sunk on the vein to a depth of 50 feet. Two men are employed. Owners, Chas. M. Walker, and W. A. Wolff, of Guatay.

Granite Mountain Mine is located on the southwest slope of Granite Mountain at an elevation of 4100 feet. It comprises seven claims in Secs. 15, 16, 21, and 22, T. 13 S., R. 5 E., S. B. M., and is about 10 miles southeast of Julian. Owner, Gus Redman, Julian. Under lease to the *Imperial Mining Company:* Bryant Howard, president, San Diego.

The formation is mica schist, and the gold values are in the quartz veins. The principal development work is on a vein which has a northerly course, and which dips 60° W. It has a width of six inches to two feet. A tunnel has been driven north on this vein for 60 feet. About 50 feet above this tunnel, another tunnel has been driven north on the vein 200 feet. Near the top of the ridge is a quartz vein about 8 feet wide, which has a strike of N. 60° W., with a dip of 45° NE. Another large quartz vein with a width of 10 feet runs about 200 feet south of the mill, and strikes N. 30° W., dipping 70° W. The ore from the upper tunnel is dumped into an incline shoot to a small bin at the mill.

Mill: A small Universal crusher, centripact pulverizer, and cyanide tanks. Mill is driven by a 4-cylinder Studebaker motor. Water is secured from Potters Springs 3½ miles west of Granite Mountain. Four men are employed.

Bibl: State Mineralogist's Report, XIV, p. 660.

High Peak Mine comprises four claims known as High Peak, Rosalyn, South High Peak, and Roosevelt, located in Secs. 31 and 32, T. 12 S., R. 4 E., S. B. M., in the Julian Mining district, one-fourth mile east of Julian. Owners, L. A. Smith and Joseph Marks, of Julian. Elevation 4400 feet.

Two parallel veins occur in the schist and strike northwest, dipping 70° NE. These veins vary in width from 1½ to 4 feet.

Developments consist of a shaft 330 feet deep and a tunnel 375 feet in length driven on the vein. Present development work is confined to the tunnel. This mine is worked in a small way.

Bibl: State Mineralogist's Report, X, p. 542; XII, p. 241; XIII, p. 339; XIV, pp. 656, 659.

Shaft and Hoist at Last Chance Mine, Boulder Creek District, San Diego County

Kentuck S. Mine is one-half mile northwest of Banner, at an elevation of 3400 feet. Holdings comprise two claims, the Kentuck S. and Cincinnati Belle in Sec. 3, T. 13 S., R. 4 E., S. B. M. Two parallel veins occur in the schist, the strike being N. 30° W., and the dip 70° NE.

The old workings have been cleaned out and retimbered. The underground workings on the Kentuck S. claim consist of a crosscut tunnel driven southwest 350 feet. This tunnel intersects a 3-compartment shaft which was sunk to a depth of 100 feet, about 100 feet southwest of the portal. On the Cincinnati Belle claim is a vertical shaft 230 feet deep; also a tunnel driven southwest 200 feet. Two men are employed. Owner, C. A. Shindler, 340 Sixth Street, San Diego.

Last Chance Mine. This property comprises five claims in Sec. 4, T. 14 S., R. 3 E., S. B. M., in the Boulder Creek mining district, on the west slope of the Cuyamaca range of mountains, 12 miles southwest of Julian. Elevation 3000 feet. Owners, *International Gold Mines Company;* L. E. Meyer, president; F. C. Clark, secretary. Offices, 858 Seventh Street, San Diego.

The country rock is granite. The vein which strikes N. 20° W. has a vertical dip, and is evidently a fault fissure in the granite. The width of the vein varies from 12 inches to 4 feet. A 2-compartment shaft has been sunk on the vein 75 feet. At the bottom of the shaft the vein has a width of 4 feet. The ore shoot which outcropped north of the shaft was underhand stoped to a depth of 25 feet. Twenty tons of ore milled from these workings is stated to have plated $18 per ton in gold.

The quartz shows some free gold associated with pyrite and marcasite. A number of parallel veins on the property have been prospected by shafts and opencuts.

Equipment consists of a 4½-h.p. Fairbanks-Morse gas engine, 8″ x 8″ Duplex compressor driven by a 15-h.p. Samson gas engine, blacksmith shop, cars, and air drills. Two men are employed.

Lookout Group of claims consists of six claims located on Mineral Hill in Sec. 10, T. 14 S., R. 3 E., S. B. M., in the Boulder Creek mining district, 14 miles southwest of Julian. This prospect was located by George H. Moyer, William Acheson and associates, of San Diego.

The country rock is mica schist. A series of parallel veins strike north and vary in width from 12 inches to 2 feet. Developments consist of opencuts, shallow shafts, and short tunnels. Two men are employed.

Madden Group of mines comprises five claims: Madden, Antelope, Curry, Gopher, and Madden Millsite, located in Secs. 3 and 4, T. 13 S., R. 4 E., S. B. M., one mile northwest of Banner in the Julian mining district. Owner, C. W. Curry, of Julian. Elevation 3500 feet.

The main workings are confined to the Antelope and Madden claims. On the Antelope claim is a crosscut tunnel driven southwest 550 feet. The vein cut in this tunnel is 12 to 18 inches wide, with a northwest strike, and has a dip of 70° SW. About 300 feet of drifts are on the vein.

On the Madden claim the workings consist of an incline shaft on the vein to a depth of 100 feet, and a drift north 60 feet. Two veins 12 inches in width occur in the schist. They strike northwest and dip 70° SW. The original shaft; now caved, was 200 feet deep, and is said said to have 500 feet of drifts. Two men are employed on development work.

Margaret and Lucky Baldwin Claims are two patented claims in Sec. 31, T. 14 S., R. 5 E., S. B. M., in the Deer Park mining district, 9 miles northwest of Descanso. Owner, James S. Burns, Guatay.

Four parallel veins with widths varying from 12 inches to 2 feet occur in the granite. They have a general northerly strike, and dip 50° E. A shaft 80 feet deep has been sunk on the Margaret claim. The quartz is mineralized with pyrite, marcasite, and arsenopyrite.

Melba Group of mines is on the west slope of the Laguna range of mountains, about 10 miles east of Descanso. The claims are known as the Martha, Elizabeth, Rose, Florence, Grace, and Melba. They are located in Secs. 4 and 9, T. 15 S., R. 5 E., S. B. M., east of the Frances group of claims, and 1¼ miles north of the Noble mines. Owners, J. B. Current and Randcliff Haniman, of San Diego.

The vein system consists of five parallel veins that form bold outcrops in a belt of mica schist. This schist belt is a mile wide and extends south several miles between a granite formation. The veins strike N. 30° W., and dip steeply to the northeast. Width varies from 4 to 12 feet. The principal veins upon which the development work has been done, are known as the Frances, Rose, Melba, and Elizabeth. Samples taken from the different workings along the outcrops of veins are stated to carry values of from $6 to $14 per ton in gold.

The main development work has been confined to the Rose and Elizabeth claims, the work on the other claims being shallow prospect shafts and opencuts made along the outcrops where the quartz pans well in free gold. The workings on the Rose claim consists of a tunnel driven north 80 feet; at 50 feet from portal there is a raise 40 feet to the surface. About 150 feet north of these workings is an opencut and short incline on the vein. The quartz is iron-stained, oxidized with occasional bunches of sulphides in the form of pyrite and marcasite. The Elizabeth vein lies approximately 600 feet west of the Rose vein. It is developed by a shaft 50 feet deep, with a drift north on the vein 70 feet and south 27 feet. A crosscut has been driven 268 feet toward the shaft; approximately 60 feet additional will have to be driven to intersect the vein. Six men are employed on development work.

Melrose Group comprises the Empire, Homestake, Stanley, and North Star claims, located in the Julian mining district, near the town of Julian. Robert Melrose of Julian, and Quayle Brothers, of San Diego.

The principal development work has been confined to the Homestake and North Star claims. Elevation 3200 feet.

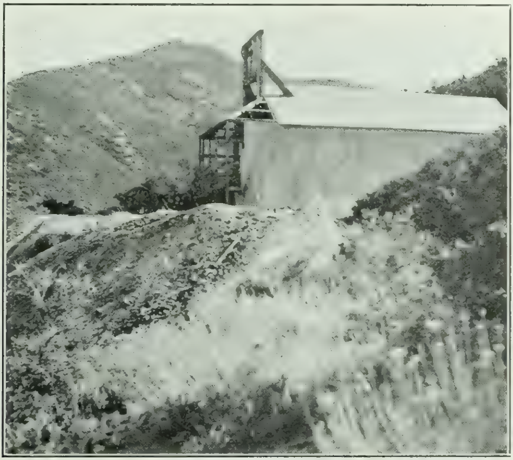
Homestake: Formerly the *Wilcox Mine*. Two veins with widths varying from 6 to 18 inches, striking northwest and dipping to the southwest occur in the schist. Developments consist of a tunnel 600 feet, and an opencut 75 feet.

North Star: It is 1½ miles southeast of Banner. Two veins 3 feet wide occur in the mica schist. They strike northwest and dip northeast. Developments consist of a shaft 50 feet deep, with drifts 70 feet on one vein. On the other vein is a shaft 115 feet deep.

Bibl: State Mineralogist's Reports: (re Homestake), XII, p. 243; XIII, p. 345. (re North Star), XIII, p. 342.

Montezuma Mine is located in the Rice or Montezuma district, about 12 miles north of Banner, and 6 miles east of Warner, on the slope of San Ysidro Mountain. The formations are metamorphic consisting of mica schist, gneiss, quartzite, and limestone, and are adjacent to a large granite area. The veins strike N. 65° E., dip 70° NW., and are well-defined fissures that cut the rocks both in strike and dip. This group of claims is owned by the *Montezuma Gold Mining Company*, of San Diego, which did considerable development on the property. At present idle.

Noble Mines are on the west slope of the Laguna Range of mountains, in what is known as the Laguna or Pine Valley district, about nine miles east of Descanso. The holdings comprise 18 claims located in Secs. 7, 8, and 17, T 15 S., R. 5 E., S. B. M. Elevation 4200 to 5000 feet. Owners, John and Thomas Noble, of Descanso. The property was discovered in 1888 by John Noble, and has been operated off and on from that date to 1914.



Shaft and Hoist at Spring Mine, Noble Mines, Laguna District, San Diego County.

The claims that have the most extensive development are known as the Eureka, Treasury, Bay View, Spring, South End, Oxide, Millsite, and Telluride.

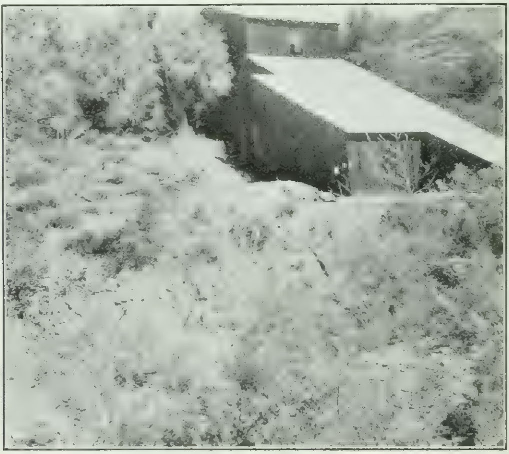
A series of parallel veins occur in a narrow belt of mica schist that strikes northwest and is about one mile wide. The veins that have been exploited occur on the ridges that lie east and west of Noble Canyon. The most productive of these have been the Bay View-Eureka and Treasury veins.

The quartz mined from these claims was hand-sorted, and packed on burros to the mill in Noble Canyon, $1\frac{1}{2}$ miles by road. It is stated that the ore milled $50 per ton. The ore extracted from the different claims on the property has paid for all development, and the owners have realized considerable profit from their operations.

Bay View-Eureka vein strikes N. 35° W. and dips 60° E. and is located 300 feet east of the west contact of schist and granite. It has a width of three feet. The workings on the Bay View claim consist of a tunnel driven southeast 50 feet on the vein, and an opencut 75 feet in length above the tunnel. The ore mined from these workings is said to have milled $10 per ton in gold. On the Eureka claim a cross vein 6 to 12 inches wide strikes N. 50° E. with a vertical dip, and cuts the Bay View-Eureka vein.

At the intersection of these two veins is an opencut 40 feet in length, and a shaft 120 feet sunk on the intersection of the two veins. The ore milled from these workings is reported to have averaged $30 per ton. The quartz shows free gold, galena, and tellurium.

Other workings on the Eureka claim consist of two tunnels; one 150 feet long, 60 feet below the surface, and the other 350 feet long, 150 feet below the above-mentioned tunnel. A shaft at the mouth of tunnel No. 1 is 100 feet deep, with drifts on the 50 and 100-foot levels, and opencuts on the lode 200 feet in length.



Five-Stamp Mill, Noble Mines, Laguna District, San Diego County.

On the Treasury claim, a tunnel has been driven southeast 330 feet on the vein which is 18 inches to 2 feet wide. This vein is 300 feet west of the Eureka vein, and occurs on the contact of schist and granite. It strikes northwest and dips 70° NE. The hanging wall is composed of schist with granite as a footwall. Near the face of the tunnel is a raise 125 feet to the surface. The ore shoot developed in this tunnel is 125 feet long, and stoped to the surface. About 200 feet below this tunnel a crosscut tunnel was driven 225 feet northeast to cut the Treasury vein.

On the top of the ridge on the Mt. Lion claim two shafts have been sunk on a vein which strikes N. 30° W. and dips 75° NE. Width of the vein is six feet with a 12-inch streak of pay ore on the footwall. Shafts are 100 feet deep.

On the Spring claims is a shaft 200 feet deep, with drifts on the 60-foot level, 80 feet; on the 100-foot level, 150 feet; on the 200-foot level, 50 feet. The shaft is vertical for a distance of 80 feet, then on the vein for 120 feet.

Considerable development work was done on the Oxide, First and Last Chance claims, which are located near the east contact of schist with the granite area. The workings are caved. The veins on these claims are 6 to 8 feet wide. The ore mined from the Oxide Mine is reported to have milled $10 per ton in gold.

Mine equipment consists of 25-h.p. West Coast gas engine hoist located at the shaft on the Spring mine.

The mill is located on Noble Creek on the Millsite claim and consists of grizzly, ore bin, Blake rock crusher, Challenge ore feeder, five 650-lb. stamps, 7-foot Lane mill, 10-foot amalgamating plates, and 2 Frue vanners. Mill is driven by a 22-h.p. Foos gas engine.

Water supply is abundant, being secured from near the head of Noble Canyon, the flume line being 3500 feet in length, giving a head of 200 feet at the plant. Seven hundred feet of 8-inch pipe connect the flume with a Knight 40-inch water wheel. Assay office, barn, and living quarters. The mines are operated at intervals by the owners.

> Bibl: State Mineralogist's Report, IX, p. 141; X, p. 544; XI, p. 382; XII, p. 238; XIII, p. 342; XIV, pp. 663–664.

Oriflamme Mine is located six miles southeast of Banner and four miles due east of the Stonewall Mine, in Sec. 1, T. 14 S., R. 4 E., and Sec. 6, T. 14 S., R. 5 E., S. B. M., on the eastern slope of the Cuyamaca range of mountains. Elevation 4500 feet. Holdings comprise 128 acres. Owners, L. S. Spaulding and Herman Ritter, Jr., of San Diego.

Two veins occur in a belt of mica schist, which is flanked on the east by granite and on the west by a broad belt of argillaceous slates. The belt of schist strikes northwest and the dip of the schist is 75° to the northeast. Total length of the underground workings is about 1000 feet. The veins have a width of four feet. The vein quartz is mineralized with pyrite and is reported to carry tellurides. The mine has not been operated since 1905, but the owners are planning to re-open the mine, and have made cyanide tests on the ore, reporting a good extraction.

> Bibl: State Mineralogist's Reports, VI, p. 89; XIII, p. 342; XIV, p. 660.

Owens Mine is one-half mile north of Julian, and comprises two patented claims known as Old Owens and New Owens; also the Janet claim (unpatented), which is the west extension of the two Owens claims, in Sec. 31, T. 12 S., R. 4 E., S. B. M. Elevation 4200 feet. Owner Howard Williams, of Julian. Under lease and bond to the *Williams Gold Mining Company;* R. F. McClellan, president; Judge D. F. Ballard, secretary; E. W. Sawtelle, treasurer; Thomas H. Teal, general manager, Los Angeles.

The property is developed by a vertical shaft 350 feet deep. It is reported that two separate veins, known as the Owens and Red Ledge, were worked through this shaft. The Red Ledge vein lies a little to the northeast of the Owens, and near the surface of the ground they are 20 feet apart. The strike is northwest and dip 80° to the northeast. The Red Ledge vein was worked to the 200-foot level, but the Owens vein was worked down to the 300-foot level for a distance of probably 400 feet along its strike, most of this distance being southeasterly from the shaft. Both veins are said to have an average width of three feet, the maximum width of the Owens vein being 4 feet. The veins, which strike N. 70° W., and dip at a high angle to the northeast, are conformable with the inclosing mica schist. A 10-stamp mill is on the property.

The mine has an estimated production of $500,000. The present company plans to sink a vertical shaft on the Janet claim to a depth of 400 feet. On this claim a crosscut tunnel has been driven southwest 125 feet to the Owens vein, and the vein drifted on both northwest and southeast. The vein exposed is 4 to 8 feet in width. Six men are employed.

Ranchita Mine is 1½ miles southeast of Banner at an elevation of 3300 feet. It comprises 160 acres of patented agricultural land, and the Elevada claim, also patented, all in Secs. 11 and 12, T. 13 S., R. 4 E., S. B. M. Owner, C. J. Couts, Vista, California.

The formation is mica schist, striking northwest and dipping 70° NE. The Ranchita vein is reported to have been made up of a series of nearly parallel quartz lenses which cut the strike of the schistose rock at an angle of 20°. These lenses seem to terminate on reaching a fault plane striking east and west. These quartz bodies were from 12 inches to 3 feet thick, and are found 4 to 5 feet apart, for some distance along the fissure. The vein was developed by a shaft 145 feet deep, from which several levels were run, and a considerable amount of stoping. On the Elevada claim the vein has a northerly strike, and dips 45° W. The Elevada vein will probably intersect the Ranchita vein about 500 feet south of the Ranchita shaft. The vein is 2 to 8 feet wide.

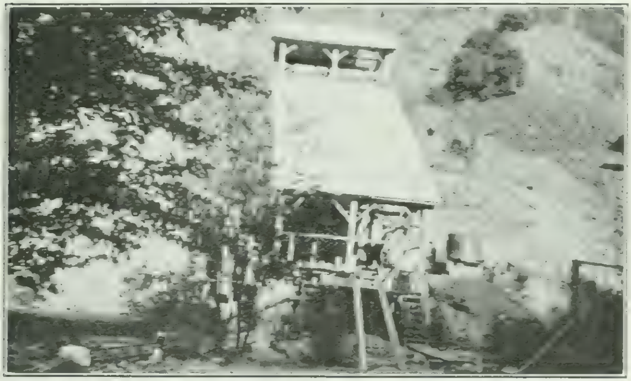
Development consists of a crosscut tunnel driven west 200 feet to the vein, with a drift 500 feet south on the vein. On the ridge above this tunnel an incline shaft was sunk to a depth of 160 feet. Levels were driven at 50 and 100 feet. Ore is stoped to the surface. This property is reported to have produced some very rich specimen ore. The reported production of the mine is $150,000.

Mine equipment consists of cars and tools. A 10-stamp mill is on the property. Under option to W. H. Knowles, of San Diego.

Ready Relief and North Hubbard Mines are situated in Secs. 10 and 11, T. 13 S., R. 4 E., S. B. M., three miles southeast of Julian in the Julian mining district. Elevation 2900 feet. The Ready Relief group, comprising 10 claims is owned by Annie Laurie and Mary A. Baily of Julian; the North Hubbard claim is owned by G. W. Hazzard of San Diego. Total area 225 acres. Under lease and bond to *Lone Pine Mining and Milling Company*, 427 Spreckels Building, San Diego. S. C. Blackman, president; Anna M. Pederson, secretary; D. B. Boyden, superintendent.

This group of mines has been one of the most productive in the Julian district. The present company started operations on the property during the latter part of 1923. The strike of the schist belt in which the North Hubbard-Ready Relief vein occurs is northwest and varies but little from this over a wide area. The country rock is a dark gray schist, having a dip of 80° E. The vein is in the form of quartz which has been subjected to stress, producing a folding of the vein. In places, several of these folds of the vein lie side by side. Where this condition occurs the pay shoot is large. The thickness of the individual rolls varies from a few inches to six feet, and where these folds parallel each other, a width of 12 feet was noted. The vein is in the form of a 'stringer lead' with occasional wide lenses of quartz, and strikes N. 60° W., dipping 70° NE. Width varies from 2 to 6 feet. The quartz is banded, and shows free gold, some pyrite and arsenopyrite.

Since the property was visited in October, 1924, development work has been confined to the North Hubbard claim, and the vein has been drifted on 500 feet NW. from the main crosscut toward the Ready Relief mine workings. At this distance a streak of high-grade quartz [illegible] to 12 inches wide was cut on the hanging wall. This is stated to assay $400 per ton. The average value of the ore mined is about $15 per ton in gold.



50-Ton Mill at North Hubbard Mine, Julian District, San Diego County.

North Hubbard workings: Crosscut tunnel driven southwest 200 feet to the vein, with drifts 500 feet northwest, and 200 feet southeast on the vein.

Mine equipment consists of an Ingersoll-Rand compressor, Ingersoll-Rand drill sharpener, air drills, cars, blacksmith and machine shop, and dwellings.

Mill equipment: On North Hubbard is a 5-stamp mill. On the Ready Relief is a 50-ton amalgamation and concentrating plant. For full description of property see State Mineralogist's Report XX, p. 373. Six men employed.

Bibl: State Mineralogist's Reports, VI, pp. 87–88, VIII, pp. 513–514; IX, p. 147; X, p. 543; XI, pp. 378–380; XIII, p. 344; XIV, p. 657; XX, p. 373.

Schley Group of claims is located in the Deer Park district, 10 miles northeast of Descanso. It comprises five claims located in Secs. 1 and 12, T. 15 S., R. 4 E., S. B. M., on the ridge east of Indian Creek. A vein of quartz four feet wide, having a strike of N. 30° W., and a dip 80° E., occurs in the granite.

Developments consist of a number of short tunnels and shallow shafts along the outcrop of the vein on the different claims. The average value of the ore is said to be about $4 per ton in gold. The quartz is oxidized being iron-stained, and shows occasional bunches of pyrite and arsenopyrite. C. M. Walker of Descanso, owner.

Silver King Mine comprises five claims located in Secs. 2 and 3, T. 14 S., R. 3 E., S. B. M., in the Boulder Creek mining district, on the ridge north of Kelly Creek, 14 miles southwest of Julian. Elevation 2500 feet. Owners, George H. Moyer, and T. E. Merritt, of Julian.

A vein four feet wide with a northwest strike and a dip 45° NE. occurs in a belt of mica schist that has a width of 600 feet.

Developments consist of three tunnels and a shaft. The lower tunnel has been driven as a crosscut 130 feet to intersect the vein, but lacks 70 feet. At a height of about 150 feet above this tunnel, a crosscut has been driven 110 feet to the vein with 70 feet of drifts on the vein. Also an intermediate tunnel has been driven 50 feet on the vein, and a shaft 50 feet deep located one-fourth mile west of these workings. The quartz contains galena with gold and silver values. Two men are employed on assessment work.

Stonewall Mine is situated on the south bank of the Cuyamaca Reservoir, 10 miles south of Julian, on the Cuyamaca Grant. The grant, including the mine, was purchased in September, 1923, by R. M. Dyar, of Beverly Hills, California, and A. B. Smith, of Cleveland, Ohio.

The country rock is banded mica schist. The vein strikes N. 35° W., and dips 65° W. The mine was located about 1870 and was worked for about five years prior to 1891 by ex-Governor Waterman of California. It was the most productive in San Diego County, the total production being over $2,000,000. The great production of the bonanza days came from a shoot some 300 feet long, which was worked to a depth of 500 feet. The vein in places was 20 feet wide. The shaft had a depth of 600 feet. The mine was closed down in 1893 and has been idle since that date.

Bibl: State Mineralogist's Reports, VI, pt. 1, pp. 89–90; VIII, pp. 515–516; IX, p. 143; X, p. 540; XI, p. 382; XII, p. 243; XIII, p. 345; XIV, pp. 660–661.

Telluride Group of claims comprises two claims known as Blue Jay and Telluride, in Sec. 31, T. 14 S., R. 5 E., S. B. M., Deer Park mining district, 10 miles northeast of Descanso. Owner, Mrs. James S. Burns, Guatay. These claims adjoin the Gold Standard claims on the north. Several parallel narrow veins of quartz occur in a belt of mica schist that has a general northwest strike. The veins are from 2 to 12 inches wide, strike northwest, and dip 70° SW. The quartz is blue ribbon quartz, mineralized with galena and pyrite. The ore is reported to have values of from $15 to $30 per ton in gold.

Developments consist of a crosscut tunnel driven N. 40° E., 100 feet. At 30 feet from the portal a narrow vein 10 inches in width is cut, and a winze has been sunk on the vein to a depth of 30 feet. One man is employed.

Tom Scott Mine comprises one claim located in Sec. 31, T. 12 S., R. 4 E., S. B. M., in the Julian mining district, one-fourth mile north of Julian. Owner, Chas. W. Curry, of Julian.

Two parallel veins 18 inches wide occur in the mica schist, and strike northwest and dip northeast. Workings consist of a shaft 225 feet deep and a tunnel 300 feet in length. The shaft has been cleaned out and retimbered to a depth of 126 feet.

Van Wert Mine comprises one claim located in Sec. 31, T. 12 S., R. 4 E., S. B. M., in the Julian mining district, one-half mile northwest of Julian. Owner, Joseph Marks, of Julian. This is one of the first locations made in the Julian district, being located in 1869.

The workings comprise two tunnels, the one furthest north being a crosscut driven N. 40° E., 200 feet. The vein was intersected at about 150 feet, and has been drifted on for a distance of about 150 feet. The vein 18 inches to 2 feet wide is in mica schist, strikes N. 35° W., and dips 60° NE. It has been stoped to the surface. On the southeast end of the claim is a crosscut tunnel 200 feet in length, now caved. Idle.

Victoria Group comprises three claims located in Sec. 9, T. 15 S., R. 5 E., S. B. M., on the west slope of the Laguna Mountains, 10 miles east of Descanso. These claims are located west of the Melba group, on veins that are parallel to the Elizabeth and Rose veins. The formation is mica schist. The workings are superficial, comprising opencuts and prospect shafts along the outcrops of veins that strike N. 30° W. Width of veins 4 to 6 feet. Owners, Thomas Blair and James McKie, of San Diego.

Willhite Group comprises two claims located in Sec. 17, T. 15 S., R. 5 E., S. B. M., on the west slope of the Laguna Mountains, nine miles east of Descanso. Owner, O. D. Willhite, of El Cajon. The claims adjoin the Noble Mines on the southeast.

The formation is a mica schist. A number of parallel veins of quartz occur in the schist near the west contact of the granite. These veins strike northwest and dip 70° NE., and have widths varying from 6 to 12 feet. A number of shallow shafts, the deepest 100 feet, have been sunk on the different veins. The quartz is heavily mineralized with pyrite and arsenopyrite, with gold and silver values. Near the contact of the schist and granite is a wide outcrop of metamorphic rock and epidote mineralized with sphalerite (zincblende) said to carry silver values.

IRON.

A few deposits of iron in the form of magnetite occur near Campo, Flinn Springs, and Lakeside. Oxidized cappings of veins, which through the oxidation of sulphide ores have left a formation of gossan on the surface, also occur near Julian. The outcrop in Sec. 15, south of Julian is the gossan of the Friday vein which carries copper and nickel. An exposure of gossan also occurs at the corner of Secs. 34 and 35, T. 13 S., R. 2 E., and Secs. 2 and 3, T. 14 S., R. 2 E., S. B. M.

The deposits have been located but outside of assessment work on the claims no development has been attempted.

Iron Master Group of Claims is located six miles east of Lakeside in T. 15 S., R. 1 E., S. B. M. Eight claims have been located by B. F. Stanwood and associates of San Diego. The iron occurs as magnetite in the granite. Not enough development work has been done to determine the extent of the deposit. Two feet of ore is exposed in one prospect hole of shallow depth.

Lakeview Group of Claims is located in T. 15 S., R. 1 E., S. B. M., on the south slope of El Cajon Mountain, three miles northeast of Lakeside. Elevation 2000 feet. Owners, B. F. Stanwood and associates, of San Diego.

The ore occurs as hematite and magnetite. Analysis of ore is stated to show 70% iron, with low phosphorous and sulphur content.

Campo Iron Deposit is located two miles west of Campo, north of the highway, in Sec. 22, T. 18 S., R. 4 E., S. B. M. The ore is magnetite. From a shaft sunk in decomposed granite a large number of pieces of magnetite have been extracted, but no vein has been found in place.

LEAD.

This metal has been reported in small quantities at several points in the county, the chief occurence being 2½ miles north of Valley Center, in the NW¼ of Sec. 1, T. 11 S., R. 2 W., S. B. M. Here a vein of quartz containing zincblende and galena, with silver values occurs in the mica schist. The vein is three feet wide, strikes northwest and dips 60° SW. The workings consist of a 45-foot shaft and a tunnel 100 feet in length. Galena also occurs in some of the quartz veins on the west slope of Laguna Mountains, and on the Telluride claim in the Deer Park district.

MANGANESE.

A mile and a half northwest of Jacumba are surface indications of manganese in the form of superficial deposits of the oxide. Some manganese-stained outcrops of quartz occur in the vicinity of Campo. It does not appear as if these deposits will be of commercial importance due to the high silica content.

Jacumba Manganese Group of claims is located one mile northwest of Jacumba in Secs. 5 and 6, T. 18 S., R. 8 E., S. B. M. Elevation 2900 feet. Eight claims have been located by B. F. Stanwood and associates of San Diego. A number of silicified outcrops with a general northwest strike occur in the granite. At a number of points these outcrops are heavily mineralized with manganese oxides. Analysis of ore extracted from different prospect holes is reported as: Manganese, 7% to 22%; Iron, 14%; Silica, 16% to 25%.

MOLYBDENUM.

Molybdenite has been found at several points in the county. It occurs disseminated in flakes and small masses in a micaless granite or aplite which appears to be in dikes in the surrounding biotite granite. The principal deposits are situated northwest of Ramona; also occurrences are noted at several points between Campo and Julian.

During 1916–1917 much activity was shown in the development of these deposits on account of the market value of the metal caused by the World War. At present writing none of the deposits are being worked.

Molybdenite (MoS_2), molybdenum sulphide, contains 41% sulphur and 59% molybdenum. The principal value of molybdenum lies in its steel hardening qualities. Therefore its principal markets are in the eastern steel centers. Molybdenum steel, containing from 6% to 10% of the metal is used for highspeed cutting tools, propeller shafts, rifle barrels etc. It is used with tungsten in electric lamp filaments, and in electric furnaces. The market quotation at San Francisco in June, 1918, was $1.25 per pound for 90% MoS_2. Quotation July 4, 1925, was 85% MoS_2, 80¢ per lb.

Campo Molybdenum Deposit is on the ridge west of Campo in Sec. 9, T. 18 S., R. 5 E., S. B. M. Elevation 2650 feet. The molybdenite occurs disseminated in flakes and small masses in an aplite dike in biotite granite.

Ramona Molybdenum Deposits are the most important occurrences of molybdenite in the county, and considerable development was done on the various surface outcrops which are located from 5 to 8 miles west and southwest of Ramona, on a ridge south of San Pasqual Valley. The different deposits in this area were described in State Mineralogist's Report XVII, pp. 379–380, so only brief mention of these will be made in this report.

Bour Molybdenum Deposit is located six miles west of Ramona in Secs. 3 and 10, T. 13 S., R. 1 W., S. B. M. Owner, Mrs. E. M. Bour, 118 Harrison Avenue, San Diego. This is the most important deposit in the county, and upon which the most development work has been done.

Molybdenite occurs in flakes and small masses in an aplite dike 30 to 200 feet wide and 1500 feet in length. Two well-defined shoots of ore have been developed by opencuts about 100 feet in length, and 15 feet deep on the crest of the hill. The ore extracted from these workings is said to have carried an average of 0.5% to 1% molybdenum sulphide.

Developments consist of a crosscut tunnel 240 feet in length, driven to cut the dike. The molybdenite is very unevenly distributed throughout the rock, the greater part of the aplite dike being barren, and the mineral is only concentrated at various points along this dike. Idle.

Judson Ranch Deposit is situated five miles west of Ramona in Secs. 1 and 12, T. 13 S., R. 1 W., S. B. M., and is one mile west of the Bour Mine. Molybdenite occurs in an aplite dike in surrounding granite, and strikes east with a dip south. The dike has a width of 50 to 100 feet. The molybdenite occurs in a zone 20 feet wide, and is unevenly distributed, the greater part of the rock being barren.

Woolsey Molybdenite Deposit is eight miles southwest of Ramona and one-half mile southeast of Shady Dell Ranch on the highway to San Diego. The molybdenite occurs here in flakes and masses distributed through a biotite granite.

Molybdenite also occurs on the *Harvey Ranch* in Sec. 19, T. 15 S., R. 2 E., S. B. M., 11 miles east of Lakeside, in small flakes in aplite, and on Mayer's Ranch on the north side of Cottonwood Creek, four miles southeast of Dulzura.

NICKEL.

Nickel produced in the United States is derived principally as a by-product from the electrolitic refining of copper. The proportion of nickel coming from the domestic copper ores is undetermined but small. The bulk is produced in Canada and comes to the United States in the form of a rich copper-nickel matte from which the refined nickel is produced. More than enough to supply the needs of the United States is imported for refining and the balance is exported. No nickel is produced commercially in California. One of the principal ores is the nickel-bearing iron sulphide, pyrrhotite. It also occurs with copper ores, or combined with arsenic or sulphur or both. It is also the constituent of several cobalt ores, and is obtained as a by-product in the smelting of lead and copper ores. Pyrrhotite (Fe_7S_8), iron sulphide, contains 60.5% Fe and 39.5% S., and is often a valuable ore of nickel, containing from 3 to 5% of this metal. In the Friday Mine near Julian the ore consists mainly of pyrrhotite carrying 4% to 5% nickel.

Friday Mine is located four miles southwest of Julian in the SW¼ of Sec. 15, T. 13 S., R. 4 E., S. B. M. Owner, *Friday Copper Mining Company;* Frank Brown, president, American National Bank Building, San Diego.

On the surface the outcrop of the vein is an iron gossan consisting chiefly of limonite. This iron gossan capping strikes east, has a width of 25 to 50 feet, and can be traced west one-fourth of a mile to the Gibson property on Sec. 16. In the upper workings of the mine, copper sulphides and carbonates with a trace of nickel are present. The orebody is developed by a vertical shaft which is in gossan for 60 feet. The shaft is vertical for a depth of 130 feet. From the 130-foot level the shaft is sunk on an incline of 70° for a distance of 45 feet. On the 130-foot level an orebody 60 feet long and 20 feet wide was developed. It lies near the contact of gabbro and schist, and in places is inclosed in gabbro. On the 175-foot level only a small lens of ore was encountered. The ore consists mainly of pyrrhotite, but also contains pyrite and an iron-nickel sulphide, and is accompanied by small quantities of calcite and amphibole.

Analysis of ore made by Dearborn Chemical Company, of Chicago, Illinois, is as follows:

Silica (SiO_2)	4.80%
Iron (Fe)	38.65%
Nickel (Ni)	4.34%
Cobalt (Co)	2.37%
Arsenic (As)	5.95%
Sulphur (S)	35.49%
Copper (Cu)	Trace

Assay of selected ore said to carry 22% nickel.

The mine was originally developed as a copper property, but the ore encountered in the underground workings shows only a trace of copper. During the early part of 1924 the property was under lease to Allen R. Partridge and associates, of Los Angeles, who installed a small furnace, but their process of treatment was not successful. After a short time operations were suspended. Idle.

Bibl: State Mineralogist's Reports, XIV, pp. 666–667; XVII, pp. 380–381. U. S. Geol. Survey Bull. 640-D.

SILVER.

Silver occurs in the county associated with copper and gold ores. In addition to the silver-lead ore at Valley Center, silver occurs in quartz veins on the Willhite Group of claims, south of the Noble Mines in the Pine Valley district.

TIN.

Two occurrences have been noted in northern San Diego County. Crystals of cassiterite were found there associated with blue tourmaline crystals, amblygonite, and beryl. No commercial quantity has been developed; only small pockets have been taken out. It is reported that placer miners working the gulches on the east slope of Laguna Mountain have found small grains of cassiterite or oxide of tin in the black sand.

TUNGSTEN.

Tungsten ore in the form of scheelite (calcium tungstate) occurs associated with gold quartz veins in the Deer Park district. The most recent discovery was made on the Gold Standard group of claims. It also occurs in the Aguanga Mountains near Oak Grove Valley in the northern section of the county near the Riverside County line. Here some production has been made from the *Oak Grove Tungsten Mine*, owned by Bert Simmons and J. Wentworth, of Aguanga.

The metal tungsten is used mainly in the steel industry and in the manufacture of electrical appliances, including the well known tungsten filament lamps. Because of its resistance to corrosion by acids, it is valuable in making certain forms of chemical apparatus. Its employment in tool-steel alloys permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would lose its temper. These are known as 'high speed steels,' and tungsten forms about 20% of such steel tools.

ZINC.

This metal occurs in small amounts in the county, being associated with lead ore as sphalerite (zincblende) in gold-quartz at the Descanso Mine near Descanso. It is also found associated with lead at Valley Center, and in epidosite on the San Vicente Grant. It also occurs in Deer Park and Laguna districts associated with other sulphide ores.

NON-METALLIC MINERALS.

The rapid growth of the cities on the Pacific Coast, and especially the city of San Diego, which has increased from a population of 74,500 (1920 census) to an estimated population of 135,000 has caused an increasing demand for both industrial and structural materials. San Diego County has a great variety of commercial minerals which are used locally, and a large tonnage of both industrial and structural materials are shipped north to the manufacturing centers along the

Pacific Coast. Deposits of granite, marble, and limestone are distributed throughout this county, and transportation and other facilities are gradually being extended so that the growing demand may be met. Crushed rock production is yearly becoming more worthy of consideration due to the strides recently made in the use of concrete, as well as the activity in building good roads. The most important recent developments in feldspar deposits have taken place in the county where large deposits of massive high-grade spar are being opened up. These deposits are unusually free from black mica and other deleterious iron-bearing minerals objectionable in pottery work. The more important of these minerals thus far exploited as shown by the output are clay, feldspar, gems, granite, mineral water, marble, fuller's earth, and silica.

CLAY.

San Diego County contains deposits of both pottery clay, and clays suitable for the manufacture of brick and tile. Extensive exposures of Eocene Tertiary clay and shale occur near the coast, and a number of deposits from Carlsbad south to Ladrillo have been developed on a commercial scale. Commercial deposits of fire clay have been developed six miles east of Cardiff. The exposures of clay or shale in the bluffs of Rose Canyon and extending for a distance of some three miles north from Ladrillo Station to Linda Vista have been developed and worked for years by the local brick companies. These deposits are extensive, and will readily supply the increased demand for the manufacture of brick and tile. The deposits are within close proximity to the Atchison, Topeka, & Santa Fe Railroad. A more detailed report on the clay resources is being prepared for the Bureau by Mr. W. F. Dietrich

El Cajon Kaolin Deposit is located on Cajon Mountain, at an elevaof 2500 to 2700 feet, 4½ miles northeast of Lakeside. Owner, *American Pottery Company*, of Los Angeles. Holdings comprise two claims in T. 14 S., R. 2 E., S. B. M. The clay is an impure white kaolin, containing varying amounts of grit. It has been exposed at various points on the mountain, and appears to occur in a zone that has a general northeast strike.

The deposit is developed by a number of tunnels and shafts, the main working tunnel being driven northwest 75 feet, and is 50 feet below the surface. This tunnel has exposed a stratum of kaolin 50 feet thick, and near the face of this tunnel is six feet of fairly plastic material. The deposit was developed and worked in 1914 and 1916 by the *California Clay Products Company* with a plant at National City. The material was packed by mules over a trail to a point on the San Diego River, and then hauled by wagon to Lakeside. Due to its inaccessibility, outside of annual assessment work, there has been no work on the deposit since 1916.

Analysis of Selected Sample by Smith-Emery Company.

Silica	49.14%
Iron Oxide	1.44%
Aluminum Oxide	31.26%
Calcium Oxide	0.89%
Magnesium Oxide	0.20%
Sodium Oxide	0.51%
Loss by ignition	16.52%

Brick and Tile Manufacturers.

California Clay Products Company and Mission China Company; Victor Kremer, president; R. B. Keeler, secretary. Offices 315 Western Mutual Life Building, Los Angeles. This company owns a deposit of fire clay located in Sec. 4, T. 13 S., R. 3 W., S. B. M., five miles northeast of Cardiff. The holdings of the California Clay Products Company consist of the Pearl and the Dorothy placer claims comprising 40 acres; the Mission China Company owns two adjoining claims known as the Robert Charles and the Thomas Hewitt, also 40 acres.

The clay is a white, semi-plastic fire clay. It does not develop sufficient plasticity to be used alone, and is of value principally for its refractory qualities. A number of test pits and benches have been dug, exposing the clay over a considerable area. Mining is being done on the Pearl claim, where a small opencut has been excavated. The exposed bank of clay is 10 to 12 feet high.

Material from the opencut is trammed to a loading bin, from which it is hauled by trucks to Carlsbad. One carload per week is being shipped. The material goes both to the company's plant at Los Angeles, and to the Vitrified Products Company's plant at San Diego. These companies are controlled by the Victor Kremer Enterprises.

Los Angeles Pressed Brick Company; Howard Frost, president; H. B. Potter, secretary. Offices, Frost Building, Los Angeles.

This company owns a deposit of fire clay on the same bed as that being worked by the Vitrified Products Company of San Diego, on the east side of a low hill on which the clay occurs. It adjoins the Vitrified Clay Products Company deposit on the southwest.

The clay bank is exposed by an opencut with a 30-foot bank. The clay is a white, semi-plastic material, being more uniform in character than on either of the other two developed properties in the district, but is somewhat sandy in places, and the iron content varies. The clay from the opencut is transported in cars to the loading bin, from which it is hauled by motor truck to Cardiff.

The production is three to four cars per week for part of the year, the annual production being 100 to 150 cars per year. The product is shipped to the Los Angeles plant of the company, and is used in the manufacture of face brick.

Morris Clay Deposit; H. T. Morris, of Escondido, owner. This deposit is located one mile south of Richland Station on the Escondido branch of the Santa Fe Railroad.

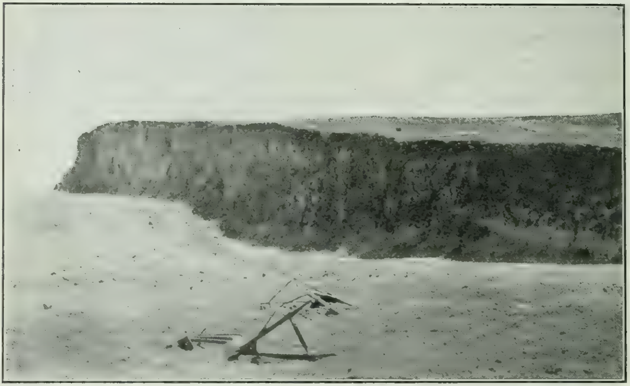
The clay occurs in a low hill, and is covered with black adobe soil. The deposit is 15 feet in thickness and underlies several acres of land. It has not been developed, therefor good exposures of fresh clay are lacking.

Morton Clay Deposit; G. H. Morton, Elsinore, owner. This deposit lies three miles east of Farr Siding, on the Santa Fe Railroad, one mile south of Carlsbad. Holdings comprise 30 acres. The clay is said to be a white, plastic, vitrifying clay, slightly iron-stained. The deposit has not been developed to determine its extent nor the quality of the clay.

National Brick Company; William Mulford, president; Edward Harrie, Jr., secretary. Offices and plant are located at 24th Street and National Boulevard, National City. The holdings of the company comprise 13 acres, under lease from S. Christian, of National City. The company is manufacturing common red brick from adobe clay. The clay is hauled by scrapers to a hopper, from which it passes to a set of rolls where the clods are broken up. It is then conveyed over a belt conveyor to a pugmill, from which it passes to a brick press.

The brick is dried in sheds. The dried brick are fired in open oil-fired kilns. The plant is driven by a 50-h.p. electric motor, and has a capacity of 36,000 brick per day. Fifteen men are employed.

Pacific Clay Products Company; Wm. Lacy, president; W. R. Fawcett, secretary; Robert Linton, general manager. Offices, New Chamber of Commerce Building, Los Angeles.



Pacific Clay Products Company's clay pit near Farr Siding (Carlsbad), San Diego County. Photo by W. F. Dietrich.

The deposit is located three miles east of Farr Siding, on the Santa Fe Railroad. The property was formerly part of the Kelley Ranch, and comprises 25 acres.

The clay beds are exposed on a low rounded hill. The upper 10 to 15 feet consists mainly of a white, plastic, vitrifying clay that is slightly iron-stained. Underlying the bed of white clay is a bed of mixed yellow and blue plastic clay of undetermined thickness. The clay has been prospected by means of a number of test pits on the property. The mining is done with horse scrapers and plows, and with a wheelscraper drawn by a tractor. A bench has been established for mining the upper bed of white material separately from the yellow and blue. The exposed bank of white clay is 275 feet long. The present production is 20,000 tons per year and is hauled to Farr Siding by trucks.

San Diego Brick and Tile Company; Wm. Roffe, president. This company controls 100 acres of land in Rose Canyon. The material used is an Eocene clay and Tertiary shale, which is for the most part thin-bedded, moderately hard, and yellowish gray in color. The clay pit and plant are on the west side of the canyon. The clay is scraped into chutes alongside of the Rose Canyon Road, at a point 50 feet vertically above the yard. The clay bank exposed is about 75 feet high, and 300 feet long. Practically no overburden is present. The clay from the chutes is hauled by cars to the dry pan and stiff mud machine. The dry press has a capacity of 20,000 brick per day. The brick are dried partly in the open air and partly under sheds, and are fired in open oil-fired kilns. This company manufactures common brick and hollow building tile. The plant is operated as required to supply local demand.

Union Brick Company; J. C. Rice, secretary, San Diego. The company's plant is located in Rose Canyon, 10 miles north of San Diego. The clay mined is from exposures of Eocene Tertiary clay and shale in the bluffs of Rose Canyon. It is thin-bedded, hard, and yellowish in color, forming a bank 50 feet or more in height. Underlying this material is a bed of plastic clay or shale, blue-gray in color.

The clay is mined by Fordson Tractors and scrapers which dump the material into a chute leading to the brick yard in the bottom of the canyon. The plant is equipped with dry pan and two presses; bricks are burned in oil-fired field kilns. Fuel oil is used for burning, and electric power for operating presses.

Vitrified Products Corporation; Victor Kremer, president; George W. Kumer, general manager; John F. Keenan, superintendent. Office, 523 Spreckels Building, San Diego. This company owns clay deposits at Cardiff and Linda Vista.

The Cardiff deposit is located five miles northeast of Cardiff, a station on the Santa Fe Railroad, in Lot 18, Rancho Las Encinitas, and comprises 16.6 acres. The fire clay has been exposed on the east and west sides of a small hill by two opencuts with a bank of 15 to 20 feet. This bed is from 10 to 12 feet thick, and is overlain by a thin layer of soil and yellow, sandy clay. The beds are nearly horizontal. Underlying the fire clay is a bed of soft, loosely consolidated sandstone, containing clay as a filling material. The fire clay is moderately hard and varies in color from a buff to blue-gray and light purple. The production varies according to the demand, one to two cars per week being mined and shipped from a siding one mile south of Cardiff.

The Linda Vista deposit is located on the south side of the santa Fe Railroad, about two miles north of Linda Vista Station, in Sec. 9, T. 15 S., R. 3 W., S. B. M. Holdings consist of 300 acres, most of which is underlain by clay beds. The deposit has been opened up by a clay pit 300 feet in length and 50 feet high, adjacent to the railroad tracks. The material being mined is a clay shale. Interbedded in the shale are beds of siliceous sandstone, about 12 inches thick. These are sorted from the clay wherever possible. The clay is light yellow in color, with iron staining in the bedding planes. The overburden varies from one to three feet in thickness. The total thickness of the clay beds is probably not less than 100 feet. The production is from 200 to 300 tons per week, and is shipped over the Santa Fe Railroad to the company's plant at Old Town, San Diego.

The brick and tile plant has a grinding capacity of 200 tons per day, producing 50,000 common brick and 50,000 hollow tile per day. The hollow tile and building tile are made by mixing 25% of the Cardiff fire clay with 75% of the Linda Vista clay shale. The company is manufacturing hollow building, and wall tile, flue lining, face, building, sewer, vitrified, and fire brick. They also produce electric conduit pipe, and vitrified sewer pipe. A full description of the plant is contained in the State Mineralogist's Report XX, pp. 369–370.

FELDSPAR.

San Diego County contains large deposits of massive, high-grade feldspar, which is unusually free from black mica and other deleterious iron-bearing minerals. San Diego and Riverside counties are furnishing practically all the feldspar produced in California at the present time. The principal deposits that have been opened up are in the vicinity of Campo, Dos Cabezas, Lakeside, and Jacumba. Probably the largest deposit in the state is located in the Campo district, being operated on an extensive scale by the *Pacific Sanitary Manufacturing Company*, of Richmond, California.

Feldspar is used in the ceramic industry, principally in pottery, porcelain, and enamel wares, also enamel brick and tile, being a constituent of both the body and the glaze, but more especially the latter. The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20% and in some cases the potteries specify less than 5%. An important factor also is the iron-bearing minerals, such as biotite (black mica), garnet, hornblende, and black tourmaline which are frequently present in pegmatites and granites. Feldspar for pottery use should be practically free from these. The white potash mica, muscovite, is not particularly objectionable except that, being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar. Present quotations are from $4 to $10 per ton crude, according to quality.

Dehesa Cornwall Stone Deposit is an extensive deposit located in Sec. 27, T. 16 S., R. 1 E., S. B. M., on the north slope of McGinty Mountain. southwest of Dehesa. The *American Encaustic Tiling Company,* Los Angeles, mines and ships a large tonnage of this rock to its plant at Los Angeles. The material mined is a feldspathic rock which resembles orthoclase, but it is much lower in potash. It is called 'Cornwall stone.' due to its similarity to rock mined at Duroc, Cornwall, England. The product is hauled by motor truck to El Cajon, a station on the Cuyamaca branch of the San Diego and Arizona Railroad, a distance of seven miles.

Analysis by company chemist.

Silica	77.68%
Alumina	15.97%
Lime	2.80%
Iron	0.13%
Manganese	0.72%
Alkalies	2.04%
	99.34%

Dos Cabezas Feldspar Deposits are located in Sec. 22, T. 16 S., R. 8 E., S. B. M., one mile north of Dos Cabezas Siding, on the San Diego and Arizona Railroad. Owners are M. C. and M. A. Turner and associates, of San Diego. Exposures of feldspar occur here at various points along pegmatite dikes in the granite. These deposits of spar are undeveloped but the possibilities look favorable for the development of a tonnage, as the outcrops are numerous and extensive. At one place an opencut has developed 14 feet of spar which is of good quality, and unusually free from impurities such as black mica, hornblende and iron.

Lakeside Feldspar Deposit is located in Sec. 35, T. 15 S., R. 1 E., S. B. M., five miles east of Lakeside. Owners, M. C. and M. A. Turner, 923 G Street, San Diego. This deposit is developed by opencuts, and shows six feet of spar associated with silica. It occurs along a pegmatite dike in the granite, and the feldspar outcrops at a number of points within a distance of one mile along its general strike. The quality of spar is said to be good, with a high potash content. A considerable tonnage has been shipped.

Marden Feldspar Deposit is located five miles northwest of Jacumba. The holdings comprise 15 claims located along an outcrop of feldspar and silica that can be traced for a distance of five miles. The spar is of good quality. Two hundred tons of spar and 50 tons of clear silica have been mined. Both are being shipped to Los Angeles. Jack Marden, National City, owner.

Moore Feldspar Deposit is located in Sec. 36, T. 17 S., R. 8 E., S. B. M., four miles east of Jacumba. Holdings comprise 30 acres owned by Armon Moore of Los Angeles. Feldspar showing a width of from 2 to 4 feet, associated with quartz is exposed in an opencut. Fifty tons of spar of good quality are on the dump.

Mykrantz Feldspar Deposits. Feldspar and silica outcrops occur on the San Vicente Grant, four miles south of Ramona. In shallow opencuts made along the different outcrops, some spar of good quality has been exposed. Owner, J. W. Mykrantz, of Ramona.

Osborne Feldspar Deposit is located 1½ miles west of Campo, and about one mile north of the San Diego and Arizona Railroad. A number of claims have been located along extensive outcrops of spar. The material exposed is of good quality. R. C. Osborne of Oceanside, owner.

Pacific Sanitary Porcelain Company of Richmond, California, F. A. Kales, manager, owns and operates one of the largest feldspar deposits so far developed in the county, and probably the largest in California. The deposit is located on a ridge south of Cottonwood Creek, about five miles north of Campo.

A massive outcrop of silica and feldspar occurs in the granite, and is from 300 to 500 feet wide. It strikes northeast and extends for a distance of 1600 feet. The deposit has been opened up by an opencut 200 feet in width, and about 75 feet in height. The top of the outcrop is about 500 feet vertically above the floor of the opencut. The spar exposed in the face of the opencut is massive and of good quality, being free from impurities. Intermixed with this are veins and boulders of quartz, which are sorted out when mined. The spar is loaded in cars, and trammed to an incline chute which delivers it to a 40-ton storage bin. In this chute there is a section of ¼-mesh screen, to eliminate dust and fine material. From bins the material passes over a 1-inch grizzly, over-size going to a 10″ x 20″ Blake crusher. This is crushed to pass a 3-inch ring. The 3-inch material goes to a revolving screen 4 feet long, with 3-inch openings. Here water is added to wash the material. The through-size material passes to a revolving screen 8 feet long, where it is screened to ½-inch size. The over-size from both these screens is sent to belt conveyors, and conveyed to receiving bins.

The plant is operated by a Fairbanks-Morse Y-type gas engine. The company is shipping 1000 tons per month. The product is hauled by motor truck to a siding on the San Diego and Arizona Railroad, one mile east of Campo. Twenty-five men are employed.

FULLER'S EARTH.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, non-plastic, white and gray to dark green in color, and some varieties disintegrate in water. It has been used in California in clarifying both refined mineral and vegetable oils. Clays of the montmorillonite and halloysite group are being utilized by some of the oil refineries in lieu of true fuller's earth in the refining of petroleum products.

Montmorillonite (hydrous aluminum silicate) is a colloidal clay, locally called 'otaylite.' Deposits of montmorillonite occur on the mesas on both sides of the Otay River Valley. It forms a layer from 2 to 6 feet thick a few feet below the surface of the mesa, and underlying several hundred acres.

California Clay Refining Company, of Los Angeles, operates a deposit located three miles east of Otay, on the mesa south of the Otay River Valley. An opencut about 100 feet in length exposed a bed of montmorillonite 4 to 5 feet thick, overlain by an overburden of sandstone and soil. The overburden is first stripped, and then the montmorillonite is moved by scrapers to loading bins. The material is hauled by motor truck to Palm City.

General Petroleum Company deposit is located on the John Mosto Ranch, three miles east of Otay on bluffs of the mesa south of the Otay River Valley. The deposit was formerly opened up and developed by Hamburger Company of Los Angeles. In 1918 it was acquired by the General Petroleum Company of Los Angeles. This company developed it for use in the refining of petroleum products.

The deposit has been opened up for a distance of 1000 feet, exposing a bank 20 feet high above the floor of the cut. The beds of montmorillonite lie horizontally, and are 6 to 8 feet thick, overlain by an overburden of sandstone and soil 10 feet thick. About two acres of ground have been excavated. This is used for a drying and storage floor for the material mined.

The method of working consists in driving a series of laterals to the south. These are then mined out similar to working a horizontal bed of coal. The material from the underground workings is wheeled out onto the floor of the opencut, and allowed to dry. A disk plow is then run over the material to break up large lumps, after which it is handled by scrapers to the loading platform, where it is loaded onto motor trucks and hauled to Palm City for shipment to the company's refining plant at Los Angeles.

The montmorillonite is white, brown, and pink in color, and disintegrates readily when exposed to the air. Six to eight men are employed. The company has also an option on 640 acres of land on the R. E. Harrison Ranch, on the north side of the mesa, which is being prospected to determine the thickness of the beds.

GEMS.

Since 1911 the production of gem materials in San Diego has been somewhat irregular and uncertain. There has been a slight renewal of activity in the tourmaline district in the northern part of the county during the past year. The value of the uncut gem materials produced during 1923 was $8,530, and in 1924, $1,925, these being principally tourmaline, kunzite, essonite and spessarite garnets, aquamarine and pink beryl, blue topaz, and quartz crystals.

Montmorillonite Deposit, General Petroleum Company, Otay, San Diego County.

The gems of California have been described at length in Bulletin 37 of the State Mining Bureau, by Dr. George F. Kunz, of New York City, whose long experience and commanding position in the gem trade of America have given him exceptional knowledge of materials produced, and for judging their quality. The gem deposits of San Diego County are also described in detail by Dr. Frederick H. Merrill in State Mineralogist's Report XIV, pp. 691–705. Owing to the limited time allowed for field work, only those properties that were producers in the past few years will be briefly mentioned in this report.

In San Diego County the principal sources of tourmaline, kunzite, and garnet, together with the less abundant beryl, topaz, and spinel, are pegmatite dikes of large size and substantial extent, often occurring in diorite or gabbro. The most productive districts of gem-materials are Pala, Rincon, Mesa Grande, Moosa Canyon, Ramona, and Aguanga Mountain.

A. B. C. Gem Mine is located in the NW¼ of the NW¼ of Sec. 8, T. 13 S., R. 2 E., S. B. M., one mile northeast of Ramona. Owners, L. B. Spaulding and C. A. Seay, San Diego.

The gem-material occurs in pegmatite dikes in granite. This mine has produced a large amount of pink beryl. The mine has been worked at intervals since 1907. The largest production came from what is known as the Old Daggett stope, narrow, irregular workings that followed the vein on its dip for somewhat over 100 feet. During the past year a new shoot of gem-bearing clay was found north of these workings.

Bibl: State Mining Bureau Bulletin 37, pp. 140–142; State Mineralogist's Report XIV, pp. 693, 702.

Douglas Claim is situated six miles east of Pala and adjoins the Stewart mine of the American Lithia and Chemical Company of New York. The gem-bearing pegmatite dike occurs in a hornblende granite, on Tourmaline Queen Mountain. Melvin R. Gay, Box 14, Los Angeles, manager.

Ed Fletcher Jr. Mine is located in the Pala gem district, east of Pala. Ed Fletcher and William Gross, San Diego, owners.

Hercules Group of Claims is located in the Ramona district, and comprises eight claims in Sec. 8, T. 13 S., R. 2 E., S. B. M., northeast of Ramona. A small producer of pink beryl. A. W. Pray and E. G. Logan, Escondido, owners.

Little Three Gem Mine is a patented claim, located in the NE¼ of the SE¼ of Sec. 8, T. 13 S., R. 2 E., S. B. M., about two miles northeast of Ramona. The gem material occurs in pegmatite dikes in the granite. Topaz is produced and here are found crystals varying in color from white to light yellow, and sea green to sky blue. Owners, H. W. Robb and Peter Schnack, Escondido.

Pala Chief Mine, the largest producer in the Pala district, comprises five claims known as the Pala Chief, Ocean View, Goddess, Hazel Wand, and Knickerbocker, located in Sec. 14, T. 9 S., R. 1 W., S. B. M., seven miles east of Pala, and one mile east of the Tourmaline Queen Mine. Owner, *Pala Chief Gem Mining Company;* Frank A. Salmons, president; R. Fenton, secretary, U. S. Grant Building, San Diego.

The Pala Chief dike is the largest of all the gem-bearing pegmatites. It is exposed on the west side of a summit of a hill at about 1500 feet in height. Its thickness varies from 30 to 50 feet, and it dips about 15° W. The hanging wall is a dark hornblende diorite, while the footwall is a biotite granite. The material, chiefly kunzite, occurs in a reddish clay in pockets of considerable size. One of these was 3½ feet high by 20 feet long. Lepidolite in small masses is of frequent occurrence. It has also produced considerable gem-tourmalines, both red and green. The red or pink variety is called rubellite. This mine is also one of the chief sources of spodumene (kunzite), color lilac and pale pink to white.

Bibl: Bulletin No. 37, pp. 25, 31, 55, 60, 61, 87, 126, 127; State Mineralogist's Report XIV, pp. 691, 693, 694, 696–697, 707.

Sickler Mine comprises seven claims in Sec. 24, T. 9 S., R. 2 W., S. B. M., on Heriart Mountain, 1½ miles southeast of the Pala Chief Mine, and east of Pala. Elevation 1700 feet. Owner, M. M. Sickler, Pala. Here are numerous pegmatite dikes varying in direction and dip. The gem materials produced are beryl, tourmaline, and spodumene (kunzite).

Surprise Mine is located in the SW¼ of the SW¼ of Sec. 9, T. 13 S., R. 2 E., S. B. M., northeast of Ramona. Owner, J. W. Booth, of Ramona. The gem deposits occur in pegmatite dikes in the granite. The chief production has been topaz and beryl, both pink and green shades.

Tourmaline King Mine is located in the Pala district on Tourmaline Queen Mountain, about seven miles east of Pala and at a higher elevation than the Tourmaline Queen mine. Owner, R. M. Wilke, Palo Alto, California. It is on a pegmatite dike parallel to the Tourmaline Queen dike. The outcrop of this dike is on the north face of the summit of the mountain, the vein being about 7 feet wide and dipping 40° NW. The gems produced are beryl, tourmaline, and kunzite.

Tourmaline Queen Mine is located on Tourmaline Queen Mountain, and comprises three claims in Secs. 15 and 22, T. 9 S., R. 1 W., S. B. M., six miles east of Pala. Owner, *Pala Chief Gem Mining Company*, of San Diego. It is on a pegmatite dike that runs parallel to the American Lithia Company's dike, and about 600 feet higher on the mountain. The dike is about 14 feet wide, dips southwest 15°, and can be followed a considerable distance south. The workings are quite extensive. The gems produced are beryl, tourmaline, and some kunzite.

J. W. Ware, Sixth Street, San Diego, is reported to be operating the *Mountain Lily Mine,* six miles southwest of Oak Grove in the Aguanga Mountains.

The dike is said to be four feet wide in diorite, the gem-bearing vein being on the contact between the pegmatite and the hanging wall of diorite. The principal gem produced is a Nile green tourmaline.

GRANITE.

Granite occurs in great variety and abundance, and in excess of all possible future demands. The principal commercial deposits are located near Santee, Lakeside, and Escondido. Near Lakeside is a fine-grained 'silver gray' granite of uniform texture and color, that is especially suitable for monumental and ornamental work. Near Escondido is a deposit of dark hornblende-diorite, which is particularly suitable for monumental and decorative purposes.

The following companies and individuals are now operating:

Bernardo Granite Quarries are located on the Bernardo Ranch, near the south bank of Lake Hodges, seven miles south of Escondido. Owner, *San Diego County Water Company.* The quarries have been opened up on a belt of black granite, that has a general northerly strike.

The granite is a hornblende-diorite, black in color, and of uniform texture and quality. The Van Deventer quarry is a small opening made on some large boulders.

Equipment consists of a 30-foot derrick, 6″ x 6″ Curtis compressor, 15-h.p. Fairbanks-Morse gas engine. The stone is used for monumental purposes.

Covas Granite Quarry is located on the El Cajon Rancho, one mile south of Santee, in a low range of hills east of El Cajon and Lakeside road. Owner, J. E. Covas, of Oxnard.

Here a small quarry has been opened up on the southwest slope. The stone is a granodiorite, light gray in color, and quite uniform in both texture and color. Production amounts to about two cars per year. This is used for monumental purposes.

Block of Silver Gray Granite in Eucalyptus Quarry No. 2, Lakeside, San Diego County. Photo by W. A. Meyer.

Eucalyptus Ranch Quarry. W. A. Meyer, of Lakeside, owns and operates two quarries located in Secs. 1 and 2, T. 15 S., R. 1 W., S. B. M., two miles north of Lakeside. Holdings comprise 2500 acres, of which 80 acres cover a silver-gray granite deposit.

No. 1 Quarry: Is located in Sec. 1, on a belt of silver-gray granite from 50 to 100 feet wide, that strikes east and dips 70° N. The stone is a light gray fine-grained granite, quite uniform in both texture and color. For the most part the rock is massive and almost free from open seams. It has a remarkably straight fracture, and is easily obtained in large rectangular blocks.

Equipment consists of a 100-foot derrick and 90-foot boom, derrick hoist driven by a 35-h.p. gas engine, 10″ x 10″ Curtis compressor driven by a 50-h.p. Western gas engine.

This silver-gray granite for monumental purposes brings $3.60 per cubic foot, at the quarry, and $4 per cubic foot on cars at Lakeside.

No. 2 Quarry: Is located in Sec. 2, on a belt of dark-blue biotite-granite which strikes northeast and is about 600 feet wide. The stone is quite uniform in texture and color. The quarry has opened up a face of granite 150 feet in length and 75 feet above the floor of the quarry. Along this face are vertical and horizontal joint planes about 20 feet apart.

Equipment consists of a 75-foot derrick, derrick hoist, and 12″ x 12″ Curtis compressor driven by a 35-h.p. Samson gas engine. A stone polishing plant driven by a 40-h.p. electric motor is on the property. This plant consists of polishing and surfacing machines. The shipping yards with loading derrick are located at Lakeside, a station on the Cuyamaca branch of the San Diego and Arizona Railroad. Twelve men are employed.

Silver Gray Granite, Eucalyptus Ranch Quarry No. 2, Lakeside, San Diego County. Photo by W. A. Meyer.

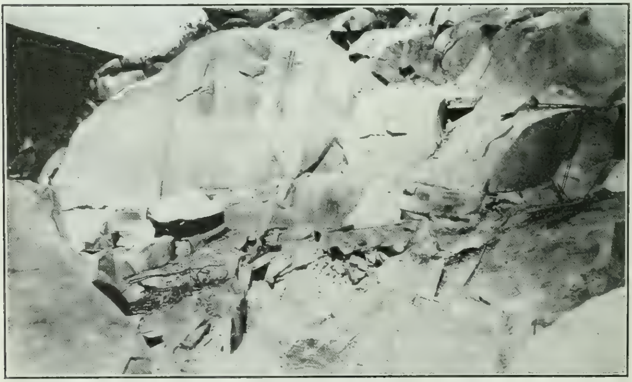
Chemical Analysis of the Silver-gray Granite by Smith-Emery Company.

Silica (SiO_2)	72.82%
Alumina (Al_2O_3)	13.36%
Ferric Oxide (Fe_2O_3) Ferrous Oxide (FeO) as Fe_2O_3	3.18%
Titania (Tio)	0.30%
Manganese Oxide (MnO)	0.28%
Lime (CaO)	2.12%
Magnesia (MgO)	0.82%
Combined water (H_2O)	0.28%
Soda (Na_2O) Potash (K_2O) by difference	6.84%
Total	100.00%

Ireys Black Granite Deposit is owned by Dr. J. T. Ireys of Los Angeles. Under lease to Arthur Greenleaf of Lakeside. The deposit is located two miles northeast of Lakeside. The stone is hornblende-diorite of good quality. The granite taken out is obtained from boulders on the surface. A small gasoline engine, air compressor, have been installed, and a small quantity of rock quarried.

McGilvray Raymond Granite Company. Office 678 South Utah Street, Los Angeles. The quarry is located 7½ miles west of Foster, in the E½ of the SE¼ of Sec. 35, T. 14 S., R. 1 W., S. B. M. It is owned by *Simpson-Pirnie Granite Company* of San Diego, but is operated under lease by the McGilvray Raymond Granite Company. Holdings comprise 11 acres.

Showing Belt of Silver Gray Granite, McKoon Granite Quarry, Lakeside, San Diego County.



Face of McKoon Granite Quarry, Lakeside, San Diego County.

Two quarries have been opened up on a belt of silver-gray granite that strikes east and is about 500 feet wide. The upper or west quarry exposes a face of granite 100 feet in length by 75 feet in height above the floor of the quarry. The east quarry exposes a face of stone about 150 feet in length. The stone appears to be more uniform, of better quality, and freer from seams and joint planes than the west quarry. The stone is a light-gray fine-grained granite, which takes a beautiful polish and is in great demand for monumental purposes. This granite is sold for \$3.60 to \$4 per cubic foot.

Equipment consists of two derricks 125 feet high, two American derrick hoists driven by electric motors, Ingersoll-Rand Imperial type (8″ x 13″) (13″ x 12″) compressor driven by 75-h.p. Westinghouse motor, blacksmith shop, and air drills. Twenty-five men are employed.

McKoon Silver-Gray Granite Quarry is located two miles west of Lakeside in Sec. 10, T. 15 S., R. 1 W., S. B. M. Holdings comprise 830 acres of patented land. Owner, Hosmer McKoon, Lakeside. The deposit lies near the summit of a low range of hills north of El Cajon Valley. Elevation 600 feet.

This belt of silver-gray granite strikes north to northwest, and is 600 feet in width. The exposure of this stone can be followed for a distance of about one mile along its strike. On a hill west of the quarry are large boulders of granite, any one of which will supply a great amount of dimension material. The stone is light gray and fine-grained, quite uniform in texture and color, has a remarkably straight fracture, and can be easily obtained in rectangular blocks as large as can be handled. There is little stripping and very little expensive waste in quarrying. The granite face exposed is about 200 feet in length and 75 feet high. This quarry was opened up in 1924 and the first carload shipped in May, 1925. This material is in demand for monumental work, as it takes a very beautiful polish.

Equipment consists of a 125-foot derrick and a Clyde derrick hoist capable of lifting 10,000 pounds on a single line; a 12″ x 10″ Sullivan compressor. Hoist and compressor are driven by a 70-h.p. St. Marys Diesel-type engine. Fifteen men are employed.

Chemical Analysis by Company Chemist.

Silica (SiO_2)	74.07%
Alumina (Al_2O_3)	16.42%
Iron (Fe_2O_3)	1.31%
Lime (CaO)	1.71%
Soda (Na_2O)	1.10%
Potash (K_2O)	4.72%
Water uncombined	0.39%
Combined water	0.28%
Total	100.00%

Rossi Quarry is located in Sec. 3, T. 15 S., R. 1 W., S. B. M., 1½ miles west of Foster. Owner, Dan F. Rossi, 3845 Imperial Avenue, San Diego.

The stone is a silver-gray granite with brownish tint on the weathered outcrop. Most of the material quarried has come from massive boulders. The quarry has been opened in two benches.

Equipment consists of a derrick 75 feet high, derrick-hoist, and 6″ x 6″ Gardner compressor, the latter driven by a 10-h.p. motor. The material is used for monumental purposes at the owner's plant in San Diego. Three men are employed.

Simpson-Pirnie Granite Company. James Simpson, president; Peter Pirnie, secretary. Office and works in San Diego. The property comprises 49 acres located near Santee Station on the Cuyamaca branch of the San Diego and Arizona Railroad.

The stone is granodiorite, locally called Santee granite, and is light gray in color. The rock is massive and free from open seams. It has a remarkably straight fracture, can be quarried in large blocks, and is quite uniform in texture and color. It is largely used for monuments. For this purpose it is cut and dressed at the company's yard in San Diego, whence it is shipped in considerable quantities to Los Angeles and other points in southern California. It also makes good building stone, for which it has been used to some extent. The production is made up of dimension stone, paving blocks, and riprap. The quarry is 200 feet in length by 75 feet high. Spur track to the quarry from the railroad.

Equipment consists of a 100-foot derrick, derrick hoist, compressor, and air drills. Electric power is furnished by the San Diego Consolidated Gas and Electric Company. Eight men to ten men are employed.

Dark Blue Santee Granite, Simpson-Pirnie Granite Quarry, Santee, San Diego County.

Stockdale Granite Quarry (*Ebony Black Granite Quarry*) comprises 30 acres located in Sec. 30, T. 12 S., R. 2 W., S. B. M., 3½ miles southwest of Escondido. Owners, Thomas Stockdale and W. Walker of Escondido.

Two quarries have been opened up on a ridge north and west of the Escondido River, on an outcrop of black granite that strikes northeast and is about 200 feet wide. The stone being quarried is a black hornblende-diorite and is quite uniform in texture and color. It is largely used for monumental purposes, also for building stone. The stone is being taken from large boulders that form the outcrop on top of the ridge.

Equipment consists of two 30-foot derricks with 28-foot booms, 6″ x 6″ Gardner-Rix compressor, and 15-h.p. gas engine. The quarry has been under operation for the past three years. From 200 to 300 cubic feet of stone is shipped to Los Angeles each month. Four men are employed.

GRAPHITE.

Kane Graphite Mine (Leebrick Mine) comprises 120 acres of patented land located in Sec. 10, T. 14 S., R. 5 E., S. B. M., on the southwest side of Mason Valley, 12 miles southeast of Julian. Owner, P. J. Kane of Julian. Elevation is between 2600 and 2700 feet. The workings consist of a tunnel driven N. 45° W., 125 feet, with a drift driven N. 80° W. on the edge of graphite schist, and several small opencuts.

The deposit is a band of graphitic schist with a maximum width of 80 feet, which is traceable for a length of about 400 feet. At the south end these schists strike N. 80° W., but farther northwest the strike is N. 45° W. The average dip is about 65° NE. The graphitic schists terminate on the southeast, just below the main tunnel. Beyond this point occur only granite, gneiss, and pegmatite. The schist carries about 11% graphite. The graphite occurs as crystalline 'flakes' disseminated through the schist. The flakes are less than 0.2 millimeters in diameter.

Seyer Graphite Mine is four miles east of Mason Valley, in Sec. 34, T. 13 S., R. 5 E., S. B. M. The deposit occurs as two graphite bands of schist 4 to 12 feet wide. Most of the graphite forms minute flakes, a small fraction of a millimeter across a fine-grained schist, but scattered through the schist. According to reports, showed 16.2% graphite. Owner, W. B. Seyer of Julian, California.

JASPER.

A deposit of red and white-banded jasper occurs southeast of Dulzura. Dr. C. C. Valle of San Diego, owner.

ORBICULAR GABBRO.

About six miles east of El Cajon on the north bank of the Sweetwater River and about one mile west of Dehesa, in Sec. 15, T. 16 S., R. 1 E., S. B M., is a large mass of gabbro, portions of which have an orbicular structure and show a highly ornamental surface when polished. This gabbro is intrusive in the midst of granite. It outcrops over an area of about a square mile on a hill near Dehesa, and extends three or four miles southwest. For a full description of the deposit see State Mineralogist's Report XIV, pp. 674–676, and State Mining Bureau Bulletin No. 38, pp. 56–61.

LIMESTONE AND MARBLE.

In San Diego County crystalline limestone occurs at many points in the areas of metamorphic rocks. The development of these deposits has been retarded due to lack of transportation in the regions where they occur. Very extensive deposits of limestone are located 4½ miles northeast of Dos Cabezas Springs, being within one mile of the San Diego and Arizona Railroad. The Verruga Marble Company owns extensive deposits of marble in Verruga Valley, southeast of Warner Hot Springs. The development of this deposit has been delayed on account of its distance from transportation.

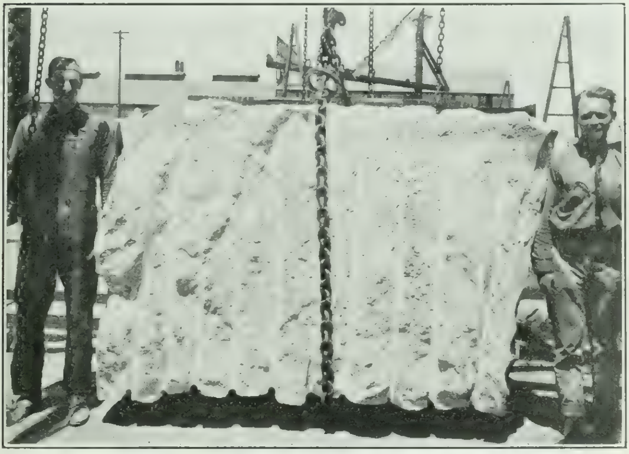
Dos Cabezas Limestone Deposit comprises 480 acres in Secs. 22, 23, 26, and 27, T. 16 S., R. 8 E., S. B. M., one mile north of Dos Cabezas Siding on the San Diego and Arizona Railroad, and nine miles north of Jacumba. Elevation 1650 to 1800 feet. Owners, M. C. and M. A. Turner and associates of San Diego.

Beds of white crystalline limestone occur in several small hills north of Dos Cabezas Siding. The limestone beds are cut by intrusions of schist and granite, and near the contact of the limestone and granite the formation is quartzite. The general strike of the limestone beds is N. 30° W., with a dip 60° NW. The belt is about one mile in length along the strike, and about three-fourths of a mile wide. One stratum extending about 600 feet in length and 20 feet in width, is pure white interspersed with tiny black dots. This stratum is a white marbleized limestone of high grade, fine-grained, slightly harder than common marble, and said to take a high polish. The different beds vary in thickness from 20 to 100 feet, and are from 300 to 600 feet in length. The largest exposure of limestone on the property is about 1½ miles north of the siding. Here a hill rises to an elevation of 800 feet above the floor of the desert. This massive bed is about 3000 feet in length by 500 feet in thickness. The limestone, where exposed by opencuts, is a coarse white crystalline lime. Analysis of samples is reported as 98% $CaCo_3$. No attempt to estimate probable tonnage was made, but it would be quite large, and would be especially suitable to furnish a sufficient tonnage for the manufacture of cement.

South Quarry, Verruga Marble Company, Verruga, San Diego County.
Photo by G. Landweer.

Deer Park Limestone Deposit is located on the Schley Group of claims in Secs. 1 and 12, T. 15 S., R. 4 E., S. B. M., on the ridge east

North Quarry, Verruga Marble Company, Verruga, San Diego County.
Photo by G. Landweer.



Block of Marble, Verruga Marble Company, Verruga, San Diego County.
Photo by G. Landweer.

of Indian Creek, eight miles northeast of Descanso. An opencut has exposed a lens of white crystalline limestone 15 feet wide. This limestone was formerly burned in a kiln on Indian Creek for use at the Stonewall mine. Owner, C. M. Walker of Descanso.

Verruga Marble Deposit comprises eight claims located in T. 10 S., R. 4 E., S. B. M., on the west slope of the San Ysidro range of mountains, one mile north of Verruga. Post Office, and 21 miles northeast of Santa Ysabel. Elevation 4500 feet. Owners, *Verruga Marble Company;* C. Harlow, president; Frank C. Webb, treasurer; W. B. Goss, secretary, San Diego.

This company opened up the quarry in 1921 and operated until 1923. At that time the property was completely equipped, both for quarrying and sawing, and polishing the material. All this equipment has been removed. Operations were suspended on account of the cost of transportation, the nearest railroad point being Lakeside on the San Diego and Arizona Railroad, a distance of 52 miles.

Where this deposit occurs the formations are metamorphic, consisting of mica schist, gneiss, quartzite, and limestone adjacent to a large granite area. The deposit occurs as two belts of coarsely crystalline limestone that strike N. 20° W., and dip 60° W. These belts are about 800 feet apart, and between the two outcrops is a band of mica schist. The west belt is about 100 feet wide, and can be traced for a distance of 1000 feet along its strike; while the east belt has a width of about 200 feet, and can be followed for a distance of 1000 feet.

Two quarries about 200 feet apart have been opened up on the west belt, and the stone exposed is a massive white crystalline marble of even texture and uniform in color and quality. The stone is a calcite marble, analysis showing 92% $CaCo_3$. It is hard and impervious to weather action. It weighs 179 lbs. per cubic foot, running 12 cubic feet to the ton. The conditions for quarrying large blocks are favorable, and when the quarry was under operation massive blocks of marble weighing 160 tons were taken out. The marble is very similar to Tate, Georgia product, but said to be harder. It is estimated that the deposit contains one million cubic feet of mercantile marble. The cost of hauling the material to Lakeside is $8 per ton.

The marble has been used in the following buildings in San Diego: San Diego Hotel Annex, Colonial Theater, Otto Building, Seiffert Building, Walk Over Shoe Store, also for the milestone for Lee Highway on the Plaza opposite Grant Hotel.

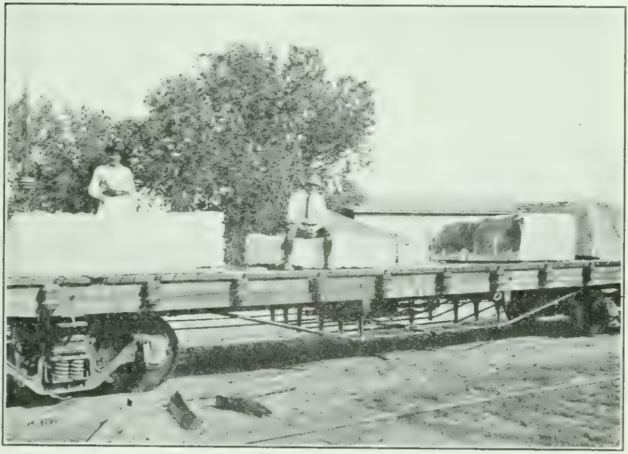
Volk Marble Deposit comprises two claims located north of the Verruga Marble deposit, being an extension of the above-mentioned outcrops of limestone. Owner, H. Volk of San Diego.

Other Outcrops of Limestone: E. Jacobs Ranch, three miles south of Ramona; another near Jacumba in Sec. 2., T. 18 S., R .8 E., S. B. M., which is a dark-gray marbleized limestone. A deposit of marble is located on top of the ridge about three miles due east of the Verruga deposit. The marble is said to be similar in character and quality to the Verruga deposit, but is inaccessible.

LIME suitable for fertilizer (agricultural lime) occurs as calcareous layers not far below the surface on Otay Mesa, near Otay and two miles north of Lakeside in Secs. 1 and 2, T. 15 S., R. 1 W., S. B. M.

Lakeside Lime and Marl Deposit is located on the El Cajon Rancho, two miles north of Lakeside, on land owned by W. A. Meyer of Lakeside. The calcareous layers are from 2 to 4 feet thick, covered with soil overburden of no great extent. The material occurs on 400 acres in Secs. 1 and 2, T. 15 S., R. 1 W. It has been used locally as agricultural fertilizer by fruit growers and farmers of the district. A determination made of the lime carbonate by the Department of Agriculture of the State of California is as follows: Calcium carbonate ($CaCo_3$) = 83.7%. Grade: Medium to high agricultural lime.

A 50-ton grinding plant has been installed on the property, where the marl is ground and screened to 20-mesh. This product is sold to the farmers at $8 per ton at the plant.



Shipment of Verruga Marble, from Verruga Marble Quarries, San Diego County. Photo by G. Landweer.

LITHIA.

Lithia mica or lepidolite, utilized in the manufacture of artificial mineral water, fire works, and glass, has been mined in San Diego County since 1899. Some amblygonite, a lithium phosphate, has been obtained from pockets associated with the gem-tourmalines. The lepidolite marketed is principally used by glass manufacturers. The lithia minerals occur in San Diego County on a northwesterly trending axis, parallel to the strike of the granite ranges, and extending from the Old Royal mine southeast of Banner, through Mesa Grande to Pala.

The *Royal Mine* lies southeast of Banner on the southwest slope of Granite Mountain, in Sec. 18, T. 13 S., R. 5 E., S. B. M. Lepidolite occurs here in a pegmatite dike.

At Mesa Grande lepidolite occurs in small masses, in the gem-bearing veins on the *San Diego, Himalaya,* and *Esmeralda* properties. No commercial production was made from these mines. This widespread and persistent lithia mineralization culminates at Pala, where are the commercially important deposits of lepidolite and also of the gem-mineral kunzite.

On the east side of the Tourmaline Queen Mountain, about 400 feet above the base, is exposed a great pegmatite dike 35 to 45 feet wide, which strikes north and dips south 5 to 10 degrees. It is exposed for a length of 3000 feet, from north to south, and has been opened at several points. Filling a fissure in this dike is a vein of lepidolite from 15 to 20 feet thick. Throughout the lepidolite, radiating masses of rubellite or pink tourmaline occur abundantly, and in occasional pockets are masses of amblygonite. The principal portion of this lithia vein is controlled by the *American Lithia and Chemical Company,* 206 Broadway, New York City.

The *Pala Lepidolite Deposit* is of great size, and its tonnage has been estimated at from 500,000 to over 1,000,000 tons. Small masses of lepidolite are found in the veins of the Tourmaline Queen and Tourmaline King mines, on the same mountain. In the Pala Chief vein the lithia mica occurs in small quantities.

The only commercially productive mine at present in the district is the *Stewart Mine,* owned by the *American Lithia and Chemical Company.* This property is only operated at intervals, according to demand from chemical and glass manufacturers.

Stewart Mine comprises the Douglas, Mission, and Stewart claims, owned by the *American Lithia and Chemical Company,* 206 Broadway, New York City. Wm. N. Crane, President; Theo. Luddum, secretary.

MICA.

This material is not abundant in San Diego County, but occurs in the Jacumba district along outcrops of feldspar and silica that occur in the granite area. The ocurrence is small, but there may be a possibility that it might be sorted out of the deposits for use as ground mica.

MINERAL PAINT.

A bedded deposit of the mineral, pinite, occurs eight miles northeast of Encinitas in Secs. 3 and 10, T. 13 S., R. 3 W., S. B. M. The deposit is traceable for a distance of some 4000 feet, its strike being nearly east, and its dip 45° N. It varies from 70 to 100 feet in width, and is underlain by diorite which forms the footwall, while the hanging wall is basalt. Near the footwall its color is reddish and yellowish, while toward the hanging wall it grows lighter in shade, passing from light yellow and gray to white. About 12 feet of this width is said to be of commercial value.

Bibl: State Mineralogist's Report XIV, pp. 668, 689–691.

SILICA (SAND AND QUARTZ).

A number of deposits of silica are found in San Diego free from iron and other impurities and suitable for use in glazes for porcelain, pottery and tile. Manufacturers of paint use finely ground silica, which forms as much as one-third of the total of some pigments for paint. The principal deposits are located near Campo, Jacumba, Boulevard, Ramona, Lakeside, and Escondido. At present writing shipments are being made from the Marden and the Walker deposits near Jacumba, to Los Angeles. In the past a considerable tonnage of sand suitable for the manufacture of glass was shipped from the beach sand near Oceanside, but this material has been entirely replaced by sand imported from Belgium.

American Encaustic Tiling Company, Los Angeles, owns a deposit of silica located two miles south of Boulevard, and six miles west of Jacumba. The deposit is a massive outcrop of quartz, about 60 feet wide and 200 feet in length, which occurs on top of a ridge in the granite area between Boulevard and Jewell Valley. The quartz is clear white, and in the openings made along the outcrop are veins and bunches of feldspar associated with the quartz. The deposit is being developed to determine its extent and quality. The silica so far exposed seems to be free from iron stain.

Beeman Silica Deposit is located between Vista and Oceanside. F. H. Beeman, 1311 E. 83d St., Los Angeles, owner. The deposit is said to be under lease to Walter Ransome, Los Angeles.

Benton Ranch Deposit. A number of bold outcrops of silica occur near Laguna Junction and six miles east of Descanso. These are northeast of the main highway to Jacumba. The quartz is clear white, and the various outcrops are extensive. No attempt has been made to develop the deposits, owing to their distance from railroad transportation.

Borden Deposit is located two miles east of Carlsbad. Undeveloped. Owner, Carol Borden of Carlsbad.

Burroughs Silica Mine comprises two claims located in Jewell Valley in Sec. 8, T. 18 S., R. 7 E., S. B. M., four miles southwest of Boulevard and seven miles west of Jacumba. Owner, J. W. Risley of San Diego.

A massive outcrop of quartz 60 feet long by 12 feet wide, and 20 feet in height occurs on the Burroughs claim in a decomosed granite. The quartz is clear white and free from iron stain and mica. Analysis: Silica (SiO_2) 99.5%; Iron (Fe_2O_3) 0.04%; Alkalies 0.01%.

On the Delphos claim one mile east of the Burroughs deposit is an outcrop of quartz located on the north slope of a round hill which is about the same size as the above-mentioned deposit. Analysis: Silica (SiO_2) 99.2%. These deposits are within three-fourths of a mile from the railroad.

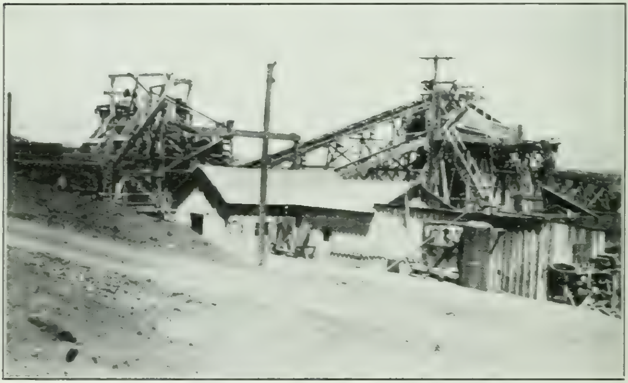
Dos Cabezas Deposits. Outcrops of quartz occur one mile north of Dos Cabezas Siding, on the San Diego and Arizona Railroad, in Sec. 22, T. 16 S., R. 8 E., S. B. M. These deposits are undeveloped, but the outcrops are extensive, and considerable clear silica could be developed. Owner, M. A. and M. C. Turner of San Diego.

Lakeside Silica Deposit is located five miles west of Alpine. Owner, M. A. Turner, San Diego. Outcrops of quartz occur within a distance of one mile along a general northwesterly strike. The principal outcrops are in Sec. 35, T. 15 S., R. 1 E., S. B. M. Quartz is associated with feldspar.

Marden Silica Deposit is located five miles northwest of Jacumba. Fifteen claims have been located along outcrops of quartz that can be followed for several miles along their strike. Considerable tonnage has been mined. The quartz is clear white, with a small amount of iron stain. Owner, Jack Marden, National City.

Osborne Silica Deposit is located 1½ miles west of Campo. Silica said to be of good quality occurs here associated with feldspar. Owner, R. C. Osborne, Oceanside.

Potrero Silica Deposit. This deposit is located in the range of mountains one mile east of Cottonwood Creek and about eight miles west of Potrero. A large outcrop of quartz 50 feet wide, associated with feldspar, occurs on the crest of the ridge. The quartz is clear white, and is reported to be very pure. Due to its inaccessibility and distance from transportation the deposit has not been developed.



G. R. Daley Rock and Gravel Plant, Murphy Canyon, San Diego County.

San Vicente Deposits. A number of outcrops of quartz occur on the San Vicente Ranch, owned by J. W. Mykrantz of Ramona. These outcrops have a general northeast strike, and where exposed, are from 6 to 12 feet wide. The quartz is white, but shows considerable iron stain along the fractures.

Sweetman Silica Deposit is located in Jewell Valley, seven miles west of Jacumba. Owner, J. W. Sweetman of Jacumba. The deposit consists of a number of outcrops of quartz that occur in the granite. Undeveloped.

Walker Silica Deposit is located in Jewell Valley, seven miles west of Jacumba. A massive outcrop of white quartz occurs on a small round hill which appears to be mostly made up of quartz. The quartz is clear white in places, but shows considerable iron stain. Opencuts made on the east side of the hill have developed quartz 80 feet in length by 20 feet wide, and 40 feet high.

Bins and loading chute have been installed and the product is hauled to Jacumba for shipment to Los Angeles. Six men are employed. Owner, Chas. Walker, Jacumba. Under lease to Jack Marden of National City.

CRUSHED STONE, GRAVEL, AND SAND.

San Diego County has an extensive area of intrusive felsite, which is now quarried at Spring Valley and could be quarried at other points. The gravel of Otay River Valley, Sweetwater, and San Diego rivers is mostly felsite with some other volcanic rock of similar qualities.

Rock and Gravel Plants.

Daley Sand and Gravel Plant. G. R. Daley of 4430 Boundary Street, San Diego, operates a plant in Murphy Canyon, north of Mission Valley, nine miles north of San Diego. The plant has a capacity of 300 cubic yards per day. The gravel pits are in Murphy Canyon, north of the plant.

The gravel is transported to the hopper by scrapers, where it is loaded onto a train of two 4-ton side-dump cars, and hauled by Plymouth gasoline motor to receiving bins. The material from these bins goes to a revolving scalping screen, where it is screened to pass a 2-inch ring, oversize from the screen going to a No. 5 Wheeling jaw crusher. Through-size falls onto belt conveyor and goes to washing plant. The product from the No. 5 Wheeling crusher goes to an Austin gyratory crusher, where it is crushed to pass a 2-inch ring. The product from the gyratory crusher joins 2-inch product from the screen on a 30-inch conveyor belt and is transported to the washing plant. At the washing plant revolving screens produce a washed gravel of the following sizes: 2″, 1¼″, 1″, ½″, ¼″, and washed sand. The plant is driven by electric power, 100-h.p. being the total used. Ten men are employed.

Fenton-Parker Materials Company; H. G. Fenton, president; G. S. Parker, secretary. Offices, 1245 National Avenue, San Diego. This company has four plants under operation, located at Chollas Valley, Otay, Spring Valley and Murray Canyon, and a sand plant at Riverview.

Chollas Valley Plant. This plant is located in Chollas Valley, three miles east of San Diego. Capacity of plant is said to be 250 yards per day. Crushed stone from cobbles, and gravel from canyon wash are used. Plant consists of conveyors, jaw crushers, and revolving screens. Products are 2″, 1″, ½″ to ¼″, and sand. These products are well washed in the washing and screening plant. Plant operated by electric power. Total 100-h.p. Eight men are employed.

Otay Plant. The plant is located near the town of Otay, on the Otay River, about one-quarter mile east of the San Diego and Arizona Railroad tracks. A spur track from this railroad to the yards of the plant affords railroad transportation. The company controls 160 acres along the river bed in Secs. 22 and 23, T. 18 S., R. 2 W., S. B. M., and the plant is located in the NW¼ of the SW¼ of Sec. 22. The capacity of the plant is 1000 tons per nine-hour day. The gravel from the river bed is delivered into a train of two 4-yard side-dump cars by a Northwest Engineering Company 40-h.p. gasoline-driven bucket hoist, and is hauled by a Plymouth gasoline motor to the plant. Here the material is dumped over grizzly bars of railroad iron spaced nine inches apart, then to a steel hopper. From the hopper material is fed to a 32-inch belt conveyor, and transported to a 4-inch grizzly, the plus 4-inch size to an Austin crusher, the minus 4-inch size to a revolving screen where it is screened to pass a 2-inch ring, and is then conveyed to the washing plant. Over-size from the screen goes to a No. 3 Gates gyratory crusher, and the product is returned to a revolving screen, where it is screened to pass a 2-inch ring. It is then conveyed to the washing plant where it is screened by a Gilbert system of screens, and log washers for sand. The products consist of 2″, 1″. ½″ to ¼″, and washed sand. The sand produced is of two grades, coarse for concrete, and fine mortar. Capacity of storage bins is about 3000 tons. After the bins are full, material of 1-inch and 2-inch size is transported to stock piles at the yard. Electric power rated at 220-h.p. is used. Fifteen men are employed.

Fenton-Parker Materials Co., Rock and Gravel Plant at Otay, San Diego County.

Murray Canyon Plant is located in Murray Canyon north of Mission Valley, about five miles north of San Diego. The plant was formerly operated by T. L. Barnes of San Diego, but recently acquired by the *Fenton-Parker Materials Company.* Holdings comprise 160 acres extending north along Murray Canyon.

From banks along the canyon the gravel is delivered into three 5-yard side-dump cars by a Northwest Engineering Company gasoline shovel. The train is hauled to the plant by a 60-h.p. Plymouth gas engine. Here the material is dumped over a 12-inch grizzly to the hopper, from which it is conveyed by belt conveyor to a No. 5 Wheeling crusher, where it is crushed to pass a 3-inch ring. From the Wheeling crusher the product is conveyed to a scalping screen where it is screened to 2-inch size. The over-size from this screen goes to a No. 4 Gates gyratory and a 3-F Telsmith crusher, the crushed product being returned to the revolving screen. It is then elevated to the washing plant, and screened by Gilbert type of screens. The following products are produced: 2″, 1½″, 1″, ½″ to ¼″, and sand. Due to the amount of clay mixed with the gravel a large amount of water is required for the washing plant, 600 gallons of water being used per minute. Also instead of using log washers for sand, a Dorr type of classifier is used, eliminating the silt. The plant has a capacity of 1000 tons per 9-hour day. Rated horsepower required to operate the plant is 240-h.p. Water for the plant is pumped from six wells in Mission Valley. Output is sold by the ton, and the trucks are weighed on scales at the plant. Fifteen men are employed. T. L. Barnes, superintendent.

Spring Valley Plant. The quarry is southwest of Spring Valley Station, on the San Diego and Arizona Railroad, on the west side of the track. The crushing plant is located on the east side of the railroad at the same point. The rock is a fine-grained felsite which forms the hill immediately north of Lemon Grove, rising some 300 feet above the mesa level. The production of crushed stone, when operating to capacity, is 500 tons per day.

The quarry face is 250 feet in length, and 100 feet above the floor of the quarry. The stone from the quarry is loaded in Kalbaugh carts, capacity being 1½ tons, onto cars having a capacity of 2½ tons. These cars are run by gravity to the bins at the plant, where the material is crushed by a No. 8 Gates gyratory crusher to pass a 6-inch ring. It is then elevated to a revolving screen, which has 2½-inch holes on the inside, with outside jacket of 2-inch openings. The 2½-inch and over goes to a No. 4 Gates gyratory crusher; the over-size from the 2-inch jacket goes to a 24-inch Symonds disc crusher. The material from the Symonds disc joins the 2-inch size from the screen and is carried by a 30-inch belt conveyor to the revolving screen, of which the inside screen is 1¼ inches, with a half-inch screen on top of the 1¼-inch and with an outside jacket of $\frac{5}{32}$-inch. The final product consists of 2″, 1″, ½″ to ¼″, and dust. The dust is conveyed to the dust pile. The crushed rock is stored in bins having a capacity of 800 tons; also on the ground in the yard. The plant is operated by electrical power, the total being 225-h.p. When operating to capacity thirty-five men are employed.

Sand Plant. This plant is located at Riverview, between Santee and Lakeside. The sand is obtained from the bed of the San Diego River. The sand from the river bed is elevated to a screening plant where it is washed and goes direct to railroad cars on the Cuyamaca branch of the San Diego and Arizona Railroad. It is then shipped into the company's yards at San Diego for building sand. Two men are employed.

Nelson and Sloan Gravel Plant is located near the town of Otay, on the Otay River. Owners, M. L. Nelson and F. R. Sloan of Chula Vista. The plant has a capacity of 200 cubic yards per day. The products are 2″, 1″, ½″ to ¼″, and washed sand. The plant is operated by electric power, the total being 84-h.p. Six men are employed.

A number of small sand and gravel plants are in operation in Mission and Otay valleys. These plants are operated steadily on account of the demand for building material in San Diego. The operators are: *R. G. Fenn* and *John Hansen* of San Diego; *I. W. Grove and Son* of

San Diego; *Nelson Cooper Company* of Otay; *Jones and Klingers* of Mission Valley; *Hans Severtson* of San Diego.

PETROLEUM.

Petroleum of commercial value has not yet been discovered in this county, although a number of wells have been drilled, and are being drilled, and the operators of these seem quite hopeful of success. While most of the wells which have been or are drilling report showings of oil and gas, the significant fact is that no actual production of oil has been obtained. These is apparently a total lack of any actual evidence of petroleum such as seepage or gas blows. The principal formations that furnish oil in California are not found in San Diego County. The upper Cretaceous strata, which probably constitute a large part of the sedimentary beds of the county, are not commercially productive in other parts of California, and there is nothing to indicate that they will be productive in the southern part of the state. The Eocene strata, although of the same age as oil-bearing strata in other parts of California, do not appear to contain oil here. The formations exposed show neither favorable structure nor contain sufficient organic material to form any noticeable quantities of petroleum. The chief encouragement to drill for oil in the western part of San Diego is stated to be the frequent occurrence on the beaches of masses of asphaltic residue.

During the years 1924 and 1925 there has been some renewal of interest in the development of oil in the county, and a number of companies have been organized to drill for oil. Development at the present time consists of four wells being drilled by various companies, but as yet no oil indications have been encountered.

These wells are as follows:

L. Overpaugh and Rufus Choate in Sec. 11, T. 17 S., R. 2 W., S. B. M.

Todd and Clark in T. 18 S., R. 1 W.

National City Oil Co., Sec. 22, T. 18 S., R. 2 W., S. B. M.

Mission Valley Oil Enterprises, Sec. 24, T. 16 S., R. 3 W., S. B. M. On July 6, 1925, this well had been drilled to 5323 feet.

Bibl: State Mining Bureau Bulletin No. 89, Petroleum Resources of California, pp. 145–148; Bull. 69, pp. 467–468; State Mineralogist's Reports XIV, pp. 708–713; XVII, pp. 381–382.

MINERAL SPRINGS.

A number of mineral springs have long been known in this county, some of which have a high reputation as curative agents. For some years the annual production and sale of bottled water has been considerable. The principal springs are here enumerated:

Borrego Springs is located in Sec. 17, T. 11 S., R. 7 E., S. B. M., on the west bank of the broad Barrego Wash, on the western side of the Colorado Desert. It is about 33 miles by road northeast of Julian. The water of this spring, although somewhat alkaline, is entirely usable. Mesquite trees grow near the spring and in the valley, and salt grass, willow, and rushes are abundant. An old cabin stands on the bank about 50 feet from the spring and serves to mark its position.

Bradley Spring is situated six miles northward from the railroad station at Foster, 1775 feet in elevation. The water issues at the base of a granitic boulder in a steep ravine, where it is collected in a cemented reservoir, which is piped to a storage tank at the roadside. This is sent to San Diego and bottled as table water.

Buckman Springs, J. S. Hayden, owner, are about 60 miles east of San Diego in Sec. 20, T. 16 S., R. 5 E., Post Office, Campo. This group consists of six small carbonated springs, 3400 feet in elevation, with water at a temperature of 60–65° F. Approximate yield is five gallons per minute. The water is bottled, charged with natural carbonic gas and shipped in large quantities. An analysis by Smith, Emery & Co. follows:

	Grains per U. S. gal.
Silica (SiO_2)	5.55
Alumina (Al_2O_3)	0.43
Iron bicarbonate ($Fe(HCO_3)_2$)	2.45
Calcium bicarbonate ($Ca(HCO_3)_2$)	61.90
Magnesium bicarbonate ($Mg(HCO_3)_2$)	10.18
Magnesium sulphate ($MgSo_4$)	4.75
Calcium sulphate ($CaSo_4$)	0.86
Magnesium chloride ($MgCl_2$)	2.09
Manganese perchloride ($MnCl_4$)	Trace
Potassium chloride (KCl)	1.21
Lithium chloride ($LiCl$)	14.93
Sodium chloride ($NaCl$)	47.65
Sodium nitrate ($NaNO_2$)	Trace
Sodium bicarbonate ($NaHCO_3$)	6.03
Total solids per gallon	158.03

El Granito Mineral Springs are about one mile southeast of El Cajon, in 70 acres of the El Cajon Grant, described as the SW¼ of the SW¼ and E½ of the NW¼ of SW¼ of Sec. 14, T. 16 S., R. 1 W. Owner, *El Bonito Springs Bottling Company,* 1436 Market Street, San Diego.

This water was from earliest times greatly valued by the Indians for its curative properties in regulating the digestive functions. The spring is 500 feet in elevation, has a temperature of 62° F., and has an approximate yield of three gallons per minute.

Analysis.

By Joseph Luce, Salt Lake City.

	Grains per U. S. gal.
Sodium chloride	2.448
Potassium carbonate	6.810
Sodium bicarbonate	14.164
Sodium carbonate	7.390
Potassium sulphate	.168
Magnesium sulphate	16.873
Aluminum oxide	.540
Calcium oxide	.392
Iron oxide	Trace
Silicium oxide	.927
Carbonic acid (free)	2.216
Organic matter	Trace
Total	51.928

The property is equipped with a bottling plant in operation since 1913.

Jacumba Hot Springs are about 24 miles east of Campo, on the line between Secs. 7 and 8, T. 18 S., R. 8 E., and about one-fourth mile north of Monument No. 233 of the international boundary, at an elevation of 2825 feet. They are all on the west side of the long valley of Carrizo Creek, whose outlet is to the northeast, through a deep narrow gorge, of which the greater part, including its head, is in Mexico. The springs include one of cold water, and several that yield waters with temperature ranging from 86° to 98° F. Total yield is about 15 gallons per minute. These thermal waters are regarded as medicinal, and a bath house and other accommodations are provided for travelers and pleasure seekers. Owner, B. L. Vaughn of Jacumba.

Nuvida Mineral Spring is about ten miles east of San Diego and was formerly known as *Isham's Spring*. It is located in the Jamacha Grant, north of the Sweetwater Reservoir.

Analysis.	Grains per U.S. gal.
Sodium chloride	16.32
Potassium chloride	1.98
Magnesium chloride	10.10
Calcium chloride	2.93
Calcium carbonate	11.19
Magnesium sulphate	3.48
Iron peroxide	.03
Manganese carbonate	.17
Silica	3.09
Alumina	.09
Total solids per gallon	49.75

Warner's Hot Springs, long known to the natives as *Las Aguas Calientes*, consists of six springs situated at the northeastern margin of the old grant known as San Jose del Valle, and by county highway are about 67.6 miles from San Diego. These springs are 3150 feet in elevation and discharge into a ravine in the Palomares Mountains about 150 gallons a minute of water having a temperature of from 131–139° F. Owners are Guy K. Woodward and Ralph Jasper, who conduct a hotel and sanitarium on the property. The post office is known as Warner Springs.

Analysis.	Grains per U. S. gal.
Sodium sulphate	5.65
Sodium sulphide	3.53
Silica	3.44
Sodium silicate	2.64
Sodium carbonate	2.63
Sodium	2.39
Potassium sulphate	0.43
Calcium silicate	0.38
Calcium phosphate	0.11
Ammonium	0.09
Magnesium sulphate	0.09
Sodium biborate	0.09
Ferric oxide	0.04
Lithium	Trace
Strontium	Trace
Magnesium oxide	Trace

Bibl: State Mineralogist's Report XIV, pp. 717–722; U. S. Geol. Survey Water Supply Paper 338, 'Springs of California', U. S. Geol. Surv. Water Supply Paper No. 224, pp. 84–87.

OIL FIELD DEVELOPMENT OPERATIONS.

By R. D. Bush, State Oil and Gas Supervisor.

From April 12, 1925, to and including July 18, 1925, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
COLUSA COUNTY:					
S. H. Keoughan, trustee	31	18	4	1-A	Colusa County
FRESNO COUNTY:					
Pacific Oil Co.	7	20	15	16	Coalinga
Pacific Oil Co.	13	20	14	34	Coalinga
Pacific Oil Co.	25	20	14	66	Coalinga
Pacific Oil Co.	25	20	14	68	Coalinga
Paragon Oil Co.	17	19	15	17	Coalinga
Penn Coalinga Petroleum Co.	1	20	14	15	Coalinga
Zier Oil Co.	1	20	14	1-N	Coalinga
Zier Oil Co.	1	20	14	2-N	Coalinga
Zier Oil Co.	1	20	14	3-N	Coalinga
Associated Oil Co.	35	13	16	1	Fresno County
Associated Oil Co.	14	15	18	1	Fresno County
Associated Oil Co.	15	16	19	1	Fresno County
KERN COUNTY:					
C. G. Cragin & V. E. Sack	29	25	19	1	Devils Den
Gross Drilling Co.	26	30	24	1	Elk Hills
Pacific Oil Co.	27	30	24	24	Elk Hills
Pan American Petroleum Co.	1	31	24	Crampton 5-I	Elk Hills
Standard Oil Co.	31	30	25	Kern Co. Lease 1 23	Elk Hills
Standard Oil Co.	31	30	25	Kern Co. Lease 1 24	Elk Hills
Standard Oil Co.	36	30	24	Tupman 44	Elk Hills
Union Oil Co.	26	30	24	Elk Hills 11	Elk Hills
Boston Petroleum Co.	20	28	28	24	Kern River
George F. Getty, Inc.	28	27	27	Dale 1	Kern River
George F. Getty, Inc.	32	27	27	Grimes 1	Kern River
George F. Getty, Inc.	22	28	27	Tegeler 1	Kern River
Loscal Petroleum Co.	21	28	28	17	Kern River
Petroleum Securities Co.	22	28	27	1	Kern River
Revenue Oil Co.	4	29	28	23	Kern River
Standard Oil Co.	21	28	27	2	Kern River
Standard Oil Co.	15	28	27	4	Kern River
Tarr & McComb	8	29	28	8	Kern River
J. C. Theriot	23	29	27	1	Kern River
E. P. Thomas	9	29	28	4-A	Kern River
F. G. Wagner	34	28	28	1	Kern River
Universal Consolidated Oil Co.	30	26	21	14	Lost Hills
Universal Consolidated Oil Co.	32	26	21	45	Lost Hills
Barnsdall Oil Co.	30	29	22	21	McKittrick
Cyril C. Lovitt	10	30	21	1	McKittrick
Smith & McRae	4	30	22	1	McKittrick
Standard Oil Co.	25	29	21	Weston 3	McKittrick
Bell-Evans Oil Co., Inc.	35	32	23	8 and 9	Midway
Bell-Evans Oil Co., Inc.	35	32	23	10	Midway
Bell-Evans Oil Co., Inc.	35	32	23	13	Midway
H. H. Bell	6	31	23	1	Midway
Berry & Ewing	31	32	24	4	Midway
Big Ten Oil Co.	36	32	23	10	Midway
Big Ten Oil Co.	36	32	23	20	Midway
E. & M. Oil Co.	10	31	22	13	Midway
E. & M. Oil Co.	10	31	22	15	Midway
Elbe Oil Land Development Co.	6	31	23	Sue Greenleaf 1	Midway
Federal Drilling Co.	20	31	24	2	Midway
Federal Drilling Co.	20	31	24	3	Midway
Federal Drilling Co.	20	31	24	11	Midway
Formax Oil Co.	36	32	23	19	Midway
Formax Oil Co.	36	32	23	20	Midway
Formax Oil Co.	36	32	23	21	Midway
General Petroleum Corp.	32	31	24	Buena Vista 11	Midway
Gilmore Oil Co.	27	31	22	2	Midway
Gilmore Oil Co.	27	31	22	3	Midway
Honolulu Consolidated Oil Co.	4	32	24	13	Midway
Honolulu Consolidated Oil Co.	4	32	24	14	Midway
Honolulu Consolidated Oil Co.	6	32	24	23	Midway
Honolulu Consolidated Oil Co.	4	32	24	32	Midway
Honolulu Consolidated Oil Co.	6	32	24	34	Midway
Honolulu Consolidated Oil Co.	6	32	24	54	Midway
Honolulu Consolidated Oil Co.	4	32	24	62	Midway
Honolulu Consolidated Oil Co.	4	32	24	73	Midway
Honolulu Consolidated Oil Co.	4	32	24	83	Midway
Honolulu Consolidated Oil Co.	6	32	24	89	Midway

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
Manley & McGinn	15	31	22	13	Midway
Manley & McGinn	15	31	22	16	Midway
Mascot Oil Co.	26	32	23	55	Midway
Midland Oilfields Co., Ltd.	34	31	24	Thornber 5	Midway
Gus Ninkovich	6	31	23	1	Midway
North American Oil Cons.	32	31	24	4	Midway
North American Oil Cons.	30	31	24	21	Midway
North American Oil Cons.	30	31	24	22	Midway
North American Oil Cons.	30	31	24	23	Midway
North American Oil Cons.	30	31	24	24	Midway
North American Oil Cons.	30	31	24	28	Midway
Pacific Oil Co.	29	31	24	1	Midway
Pacific Oil Co.	29	31	24	8	Midway
Pacific Oil Co.	33	31	24	10	Midway
Pacific Oil Co	19	31	24	13	Midway
Pacific Oil Co.	19	31	24	15	Midway
Pacific Oil Co.	19	31	24	16	Midway
Pacific Oil Co.	19	31	24	17	Midway
Pacific Oil Co.	19	31	24	19	Midway
Pacific Oil Co.	33	31	24	19	Midway
Pacific Oil Co.	19	31	24	21	Midway
Pacific Oil Co.	19	31	24	22	Midway
Pacific Oil Co.	31	31	24	31	Midway
Pacific Oil Co.	29	31	24	40	Midway
Pacific Oil Co.	29	31	24	47	Midway
Pacific Oil Co.	33	31	24	56	Midway
Petroleum Midway Co., Ltd	34	32	24	Dorothy 2	Midway
Petroleum Midway Co., Ltd	34	32	24	Dorothy 3	Midway
John F. Philippi	4	32	23	1	Midway
Southwestern Petroleum Co	2	31	22	7	Midway
Union Oil Co.	36	30	22	Mason 1	Midway
Valley Oil Co.	14	31	22	2	Midway
Atlas Oil Co.	30	12	23	A-1	Sunset
C. J. Berry	34	12	24	Hillside 15	Sunset
Big Chief Oil Co.	2	11	24	6	Sunset
Big Ten Oil Co.	36	32	23	15	Sunset
Califroleum Oil & Gas Co.	4	11	23	4	Sunset
Lewis Petroleum Co.	34	12	24	G-M 11	Sunset
Midway Oil Co.	35	12	24	379	Sunset
Midway Oil Co.	35	12	24	376-B	Sunset
Standard Oil Co.	2	11	24	Monarch 44	Sunset
Standard Oil Co.	10	11	23	Rass 2	Sunset
Tannehill Oil Co.	34	12	24	25	Sunset
August J. Bomke	12	29	20	2	Temblor
Hall & Baker	1	29	20	1	Temblor
T. G. Hutt	30	29	21	How 1	Temblor
L. E. Westrich	24	29	20	1	Temblor
Standard Oil Co.	27	11	20	Kern Co. Lease 2 19	Wheeler Ridge
Standard Oil Co.	27	11	20	Kern Co. Lease 2 20	Wheeler Ridge
Belridge Oil Co.	32	32	23	Gonyer 1	Kern County
Fremont Oil Corp.	22	31	38	2	Kern County
Glide Petroleum Co.	11	27	28	1	Kern County
Glide Petroleum Co.	11	27	28	2	Kern County
Glide Petroleum Co.	11	27	28	3	Kern County
Glide Petroleum Co.	11	27	28	4	Kern County
Matie G. Jones	6	11	22	1	Kern County
Pyramid Oil Co.	20	32	25	1	Kern County
Smoot Oil Co.	1	27	18	1	Kern County
Standard Oil Co.	36	26	19	Lazard 1	Kern County
Standard Oil Co.	15	28	22	Miller & Lux Option 1	Kern County
Standard Oil Co.	12	25	19	S. F. and Fresno Land Co. 1	Kern County
World Oil Co.	12	11	9	1	Kern County
KINGS COUNTY:					
Louis D. Fay	28	23	19	1	Kings County
LOS ANGELES COUNTY:					
Shell Co.	34	3	13	Manuel 6	Dominguez
Shell Co.	34	3	13	Reyes 27	Dominguez
Shell Co.	34	3	13	Reyes 27-A	Dominguez
Shell Co.	33	3	13	Reyes 29	Dominguez
Union Oil Co.	33	3	13	Hellman 12	Dominguez
Associated Oil Co.	7	2	14	Vickers 3	Inglewood
Associated Oil Co.	7	2	14	Vickers 4	Inglewood
Associated Oil Co.	7	2	14	Vickers 6	Inglewood
Associated Oil Co.	7	2	14	Vickers 7	Inglewood

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Associated Oil Co.	7	2	14	Vickers 10	Inglewood
Associated Oil Co.	7	2	14	Vickers 11	Inglewood
Associated Oil Co.	7	2	14	Vickers 12	Inglewood
Associated Oil Co.	7	2	14	Vickers 13	Inglewood
Associated Oil Co.	7	2	14	Vickers 14	Inglewood
Associated Oil Co.	7	2	14	Vickers 17	Inglewood
Associated Oil Co.	7	2	14	Vickers 18	Inglewood
Associated Oil Co.	7	2	14	Vickers 20	Inglewood
Associated Oil Co.	7	2	14	Vickers 22	Inglewood
Associated Oil Co.	7	2	14	Vickers 24	Inglewood
Associated Oil Co.	7	2	14	Vickers 25	Inglewood
Associated Oil Co.	7	2	14	Vickers 27	Inglewood
Associated Oil Co.	7	2	14	Vickers 29	Inglewood
Associated Oil Co.	7	2	14	Vickers 32	Inglewood
Associated Oil Co.	7	2	14	Vickers 34	Inglewood
Brownmoor Oil Co.	7	2	14	1	Inglewood
Brownmoor Oil Co.	8	2	14	2	Inglewood
Brownmoor Oil Co.	8	2	14	3	Inglewood
Brownmoor Oil Co.	7	2	14	5	Inglewood
Brownmoor Oil Co.	7	2	14	6	Inglewood
Brown Shasta Oil Co.	8	2	14	1	Inglewood
Brown Shasta Oil Co.	8	2	14	2	Inglewood
Brown Shasta Oil Co.	7	2	14	3	Inglewood
Brown Shasta Oil Co.	7	2	14	4	Inglewood
Brown Shasta Oil Co.	7	2	14	5	Inglewood
Brown Shasta Oil Co.	7	2	14	7	Inglewood
The 57 Petroleum Corp.	8	2	14	Moynier 1	Inglewood
Mohawk Oil & Gas Syn.	7	2	14	4	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 11	Inglewood
Pacific Oil Co.	8	2	14	Baldwin 17	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 21	Inglewood
Petroleum Midway Co., Ltd.	8	2	14	Moynier 4	Inglewood
Petroleum Midway Co., Ltd.	8	2	14	Moynier 5	Inglewood
Petroleum Midway Co., Ltd.	8	2	14	Moynier 7	Inglewood
Petroleum Midway Co., Ltd.	7	2	14	Moynier Twin 1	Inglewood
Petroleum Midway Co., Ltd.	7	2	14	Smith 4	Inglewood
Petroleum Midway Co., Ltd.	7	2	14	Smith 6	Inglewood
Petroleum Securities Co.	8	2	14	Cone 5	Inglewood
Petroleum Securities Co.	8	2	14	Cone 7	Inglewood
Petroleum Securities Co.	8	2	14	Cone 8	Inglewood
Petroleum Securities Co.	8	2	14	Cone 9	Inglewood
Petroleum Securities Co.	8	2	14	Cone 10	Inglewood
Petroleum Securities Co.	8	2	14	Cone 11	Inglewood
Petroleum Securities Co.	8	2	14	Cone 12	Inglewood
Petroleum Securities Co.	8	2	14	Cone 13	Inglewood
Petroleum Securities Co.	8	2	14	Lloyd 2	Inglewood
Petroleum Securities Co.	8	2	14	Lloyd 3	Inglewood
Petroleum Securities Co.	8	2	14	Lloyd 4	Inglewood
Petroleum Securities Co.	8	2	14	Lloyd 5	Inglewood
Petroleum Securities Co.	8	2	14	Lloyd 6	Inglewood
Petroleum Securities Co.	2	2	15	Palm Crest 1	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 1, 2, 3, 4, 5	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 6	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 7	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 8	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 9	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 11	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 12	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 13	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 14	Inglewood
Petroleum Securities Co.	8	2	14	Rubel 15	Inglewood
Shell Co.	8	2	14	Rindge 2	Inglewood
Shell Co.	8	2	14	Rindge 3	Inglewood
Shell Co.	8	2	14	Rindge 4	Inglewood
Shell Co.	8	2	14	Rindge 5	Inglewood
Shell Co.	8	2	14	Rindge 6	Inglewood
Shell Co.	8	2	14	Rindge 7	Inglewood
Shell Co.	8	2	14	Rindge 8	Inglewood
Shell Co.	8	2	14	Rindge 9	Inglewood
Shell Co.	8	2	14	Rindge 10	Inglewood
Shell Co.	8	2	14	Rindge 11	Inglewood
Shell Co.	8	2	14	Rindge 12	Inglewood
Shell Co.	8	2	14	Rindge 13	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 7	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 8	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 9	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 10	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 11	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 12	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 13	Inglewood

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Standard Oil Co.	17	2	14	L.A.Invest. 1 14	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 15	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 16	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 17	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 18	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 19	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 20	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 21	Inglewood
Standard Oil Co.	8	2	14	L.A.Invest. 1 22	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 23	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 2 3	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 2 4	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 2 5	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 5	Inglewood
Standard Oil Co.	8	2	14	Vickers 1 6	Inglewood
Standard Oil Co.	8	2	14	Vickers 1 7	Inglewood
Standard Oil Co.	8	2	14	Vickers 1 8	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 9	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 10	Inglewood
Standard Oil Co.	8	2	14	Vickers 1 11	Inglewood
Standard Oil Co.	8	2	14	Vickers 1 12	Inglewood
Standard Oil Co.	8	2	14	Vickers 1 13	Inglewood
Standard Oil Co.	8	2	14	Vickers 1 14	Inglewood
Standard Oil Co.	8	2	14	Vickers 1 15	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 4	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 5	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 6	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 7	Inglewood
Standard Oil Co	7	2	14	Vickers 3 1	Inglewood
I. W. Bailes	24	4	13	Whiston & Kackley 1	Long Beach
N. Braly and N. T. Slade	24	4	13	Engelke 1	Long Beach
Bush-Voorhis Oil Co	19	4	12	13	Long Beach
Center Oil Co.	19	4	12	1	Long Beach
Cook Oil Corp.	24	4	13	1	Long Beach
Craig, Burns & Co., Inc.	19	4	12	Reese-Benedict 1	Long Beach
Craig, Burns & Co., Inc	19	4	12	Reese-Benedict 1-A	Long Beach
Craig, Burns & Co., Inc	13	4	13	Scott-Mogle 1	Long Beach
Harry Failing	19	4	12	Finney 1	Long Beach
General Petroleum Corp.	19	4	12	K. & H. 6	Long Beach
A. T. Jergins Trust	19	4	12	17	Long Beach
A. R. Johnson	24	4	13	1	Long Beach
A. T. Kenney	24	4	13	1	Long Beach
Lindauer Oil Co.	24	4	13	1	Long Beach
Linden Oil Co.	24	4	13	1	Long Beach
O. F. W. Drilling Co., Inc.	24	4	13	1	Long Beach
J. E. O'Donnell	19	4	12	O'Donnell 39	Long Beach
J. E. O'Donnell	19	4	12	O'Donnell 40	Long Beach
J. E. O'Donnell	24	4	13	O'Donnell 41	Long Beach
J. E. O'Donnell	24	4	13	O'Donnell 43	Long Beach
Painted Hills Oil Assn	13	4	13	8	Long Beach
Pan American Petroleum Co.	19	4	12	U. P. 7	Long Beach
Pan American Petroleum Co.	19	4	12	U. P. 8	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Fields 15	Long Beach
Petroleum Midway Co., Ltd.	19	4	12	Fields 16	Long Beach
W. R. Ramsey	28	4	12	R. L. M. 1	Long Beach
San Martinez Oil Co.	29	4	12	Booth Comm.4-A	Long Beach
South Slope Oil Co.	13	4	13	O'Donnell 42	Long Beach
J. P. Spaulding	13	4	13	Probasco 1	Long Beach
Umpire Petroleum Corp.	24	4	13	2	Long Beach
The United Oil Co.	13	4	13	Bixby 2-A	Long Beach
Fred A. Walker	24	4	13	1	Long Beach
Weaver Bros.	24	4	13	1	Long Beach
McGinley Oil Co.	6	2	11	17	Montebello
St. Helens Petroleum Co., Ltd.	2	2	12	Mulholland 2	Montebello
St. Helens Riverside Properties	2	2	12	Monterey 9	Montebello
Associated Oil Co	20	3	13	Higgins 3	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 5	Rosecrans
Barnsdall Oil Co.	20	3	13	Rosecrans 6	Rosecrans
Burnham Exploration Co.	35	2	14	Wagner 2	Rosecrans
P. L. Cooper	7	3	13	1	Rosecrans
DeLendrecie Oil Well	7	3	13	Athens 2	Rosecrans
DeLendrecie Oil Well	7	3	13	Athens 2-A	Rosecrans
Elbe Oil Land Development Co.	20	3	13	5	Rosecrans
Walter H. Fisher Corp.	7	3	13	12	Rosecrans
Walter H. Fisher Corp.	7	3	13	14	Rosecrans
Fullerton Oil Co.	7	3	13	Athens 1	Rosecrans
Wm. E. Garner	7	3	13	Garner 2	Rosecrans

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
George F. Getty, Inc.	7	3	13	Athens 7	Rosecrans
George F. Getty, Inc.	7	3	13	Athens 8	Rosecrans
C. P. Harrell	7	3	13	1	Rosecrans
Henderson Petroleum Corp.	7	3	13	Athens 4	Rosecrans
Hitchcock & Ort	7	3	13	H. & O. 12	Rosecrans
Hitchcock & Ort	7	3	13	H. & O. 11	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens 4	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens 5	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens 6	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens 7	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens 8	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens 9	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens 12	Rosecrans
Julian Petroleum Corp.	7	3	13	Athens 13	Rosecrans
M. G. & N.	18	3	13	1	Rosecrans
Marine Corp.	20	3	13	36	Rosecrans
Marine Corp.	7	3	13	37	Rosecrans
Marine Corp.	7	3	13	38	Rosecrans
Marine Corp.	20	3	13	41	Rosecrans
McBride-Bremner	7	3	13	McBride 1	Rosecrans
Pacific Petroleum Corp. & The United Oil Co.	7	3	13	Athens 4	Rosecrans
Petroleum Midway Co., Ltd.	20	3	13	Colby 2	Rosecrans
Petroleum Midway Co., Ltd.	7	3	13	Kreitz Comm. 2	Rosecrans
Petroleum Midway Co., Ltd.	7	3	13	Kreitz Comm. 3	Rosecrans
J. T. Robertson Co.	7	3	13	2	Rosecrans
Sentinel Oil Co.	7	3	13	Athens 5	Rosecrans
Sentinel Oil Co.	7	3	13	Athens 6	Rosecrans
St. Helens Petroleum Co., Ltd.	20	3	13	Walsh 1	Rosecrans
Star Petroleum Co.	20	3	13	Ballsun 1	Rosecrans
Superior Oil Co.	20	3	13	Maxwell Comm. 5	Rosecrans
Superior Oil Co.	20	3	13	Maxwell Comm. 8	Rosecrans
Superior Oil Co.	20	3	13	Weaver 1	Rosecrans
Union Oil Co.	18	3	13	Howard Park 22	Rosecrans
Union Oil Co.	18	3	13	Howard Park 23	Rosecrans
Union Oil Co.	18	3	13	Howard Park 24	Rosecrans
Union Oil Co.	17	3	13	Padelford 2	Rosecrans
C. C. M. O. Co.	9	4	14	Del Amo 27	Torrance
C. C. M. O. Co.	9	4	14	Del Amo 34	Torrance
C. C. M. O. Co.	16	4	14	Del Amo 37	Torrance
C. C. M. O. Co.	9	4	14	Del Amo 69	Torrance
C. C. M. O. Co.	8	4	14	Del Amo 75	Torrance
C. C. M. O. Co.	8	4	14	Del Amo 81	Torrance
C. C. M. O. Co.	8	4	14	Del Amo 103	Torrance
C. C. M. O. Co.	8	4	14	Del Amo 104	Torrance
C. C. M. O. Co.	9	4	14	Del Amo 105	Torrance
C. C. M. O. Co.	9	4	14	Del Amo 106	Torrance
C. C. M. O. Co.	15	4	14	Torrance 75	Torrance
C. C. M. O. Co.	10	4	14	Torrance 88	Torrance
General Petroleum Corp.	8	4	14	Carson 9	Torrance
General Petroleum Corp.	8	4	14	Carson 10	Torrance
George F. Getty, Inc.	8	4	14	Torrance 26	Torrance
George F. Getty, Inc.	8	4	14	Torrance 27	Torrance
Marine Corp.	25	4	14	52	Torrance
Petroleum Midway Co., Ltd.	5	4	14	Redondo Imp. Co. 3	Torrance
Shell Co.	9	4	14	Frenger 4	Torrance
Shell Co.	9	4	14	Frenger 5	Torrance
Shell Co.	9	4	14	Torrance 4	Torrance
Standard Oil Co.	13	4	14	Dominguez 13	Torrance
Standard Oil Co.	22	4	14	Marble Lease 24	Torrance
Superior Oil Co.	19	4	13	Torrance 36	Torrance
Superior Oil Co.	30	4	13	Torrance 62	Torrance
Petroleum Midway Co., Ltd.	17	2	11	Seward-Rideout 2	Whittier
Bandini Petroleum Corp.	16	2	12	DeBaker 4	Los Angeles County
Oak Ridge Oil Co.	22	2	12	Couts Comm. 1	Los Angeles County
Superior Oil Co.	15	2	12	Vail 1	Los Angeles County
MERCED COUNTY—					
Henry L. Kuns	9	12	9	1	Merced County
NAPA COUNTY—					
Griffiths Oil Co.	7	8	3	6	Napa County

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—					
C. C. M. O. Co.	9	3	9	97	Brea Olinda
Union Oil Co.	10	3	9	Olinda 2	Brea Olinda
Union Oil Co.	13	3	10	Graham & Loftus 56-A	Coyote Hills
Pan American Petroleum Co.	11	6	11	Johnson 4	Huntington Beach
Petroleum Midway Co., Ltd.	11	6	11	Brown 7	Huntington Beach
Petroleum Midway Co., Ltd.	2	6	11	Elliott 4	Huntington Beach
Retsof Drilling Co.	2	6	11	74	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 21	Huntington Beach
Standard Oil Co.	34	5	11	Huntington A 28	Huntington Beach
Standard Oil Co.	3	6	11	Huntington A 29	Huntington Beach
Standard Oil Co.	2	6	11	Huntington B 35	Huntington Beach
Standard Oil Co.	27	5	10	Santa Ana Gardens 1	Huntington Beach
Sun Oil Co.	2	6	11	7	Huntington Beach
Beesemyer & Yerkes	28	6	10	Elmer 2	Newport
Beesemyer & Yerkes	28	6	10	Orange Co. 3	Newport
A. T. Jergins Trust	21	6	10	1	Newport
Jesse M. Nelson Co.	16	6	10	1	Newport
Barnett Rosenburg	21	6	10	1	Newport
Barnett Rosenburg	17	6	10	Fairview Farms 1	Newport
Warrington & DeKay	28	6	10	1	Newport
F. A. Winchester	23	6	10	2	Newport
Chiksan Oil Co.	32	3	9	4	Richfield
Petroleum Midway Co., Ltd.	33	3	9	Richfield Consolidated 10	Richfield
Hoyt S. Gale	31	5	9	Irvine 1	Orange County
RIVERSIDE COUNTY—					
Trabuca Oil Co.	28	4	6	1	Riverside County
SAN BERNARDINO COUNTY—					
Hesperia Oil & Gas Co.	29	4	4	1-A	San Bernardino Co.
SAN JOAQUIN COUNTY—					
Pacific Petroleum Producers	12	4	7	1	San Joaquin County
SAN LUIS OBISPO COUNTY—					
Barneberg Oil Co.	--	32	15	1	San Luis Obispo Co.
E. F. Brittan	27	32	12	1	San Luis Obispo Co.
SAN MATEO COUNTY—					
Rollo Ellis	21	7	4	1	San Mateo County
La Honda Oil Fields Assn.	--	7	4	3	San Mateo County
SANTA BARBARA COUNTY—					
Pan American Petroleum Co.	--	9	34	Soladino 15	Casmalia
Marland Oil Co.	32	9	32	Williams 1	Cat Canyon
Palmer Union Oil Co.	30	9	32	Stendell 5	Cat Canyon
R. & G. Oil Co.	30	9	32	11	Cat Canyon
Rice Ranch Oil Co.	23	9	34	Radium 3	Santa Maria
G. F. Becker	Block 38, Summerland			1	Santa Barbara Co.
James F. Nugent Oil Co.	33	4	25	2	Santa Barbara Co.
SANTA CRUZ COUNTY—					
Swanton Improvement Co.	23	11	2	1	Santa Cruz Co.
TULARE COUNTY—					
Dinuba Oil & Petroleum Co.	Lot 1 of Orr Subdivision,			Dinuba 1	Tulare County
Hub Oil Co.	26	22	27	Halbert 1	Tulare County
Pioneer Development Co.	17	22	27	2	Tulare County
VENTURA COUNTY—					
Montebello Oil Co.	4	3	19	Shiells 118	Bardsdale
C. A. Harding, Trustee	34	2	20	10	Conejo
C. A. Harding, Trustee	34	2	20	11	Conejo
C. A. Harding, Trustee	34	2	20	12	Conejo
C. A. Harding, Trustee	34	2	20	13	Conejo
C. A. Harding, Trustee	33	2	20	44	Conejo
C. A. Harding, Trustee	33	2	20	45	Conejo
C. A. Harding, Trustee	33	2	20	46	Conejo

OIL FIELD DEVELOPMENT OPERATIONS—Concluded.

Company	Sec.	Twp.	Range	Well No.	Field
VENTURA COUNTY—Continued.					
J. A. Hess	4	1	20	4	Conejo
J. A. Hess	4	1	20	5	Conejo
J. A. Hess	4	1	20	6	Conejo
Rio Virgin Oil Syn.	4	1	20	2	Conejo
Rio Virgin Oil Syn.	4	1	20	3	Conejo
Rio Virgin Oil Syn.	4	1	20	4	Conejo
Chalmers & Ford	14	4	18	1	Piru
Julian Petroleum Corp.	14	4	19	16	Piru
Schell & Jennings	32	4	18	8	Piru
Modoc Petroleum Corp.	20	5	19	2	Sespe
Oak Ridge Oil Co.	13	3	21	Harvey 17	South Mountain
Oak Ridge Oil Co.	18	3	20	Willard 18	South Mountain
Ring Petroleum Corp.	22	3	21	1	South Mountain
Santa Paula Oil Co.	18	3	20	Santa Paula 17	South Mountain
Associated Oil Co.	27	3	23	Lloyd 21	Ventura
Associated Oil Co.	27	3	23	Lloyd 22	Ventura
Associated Oil Co.	28	3	23	Lloyd 31	Ventura
General Petroleum Corp.	28	3	23	Notten 7	Ventura
General Petroleum Corp.	28	3	23	Notten 8	Ventura
General Petroleum Corp.	28	3	23	Notten 9	Ventura
J. A. Hess	34	4	23	1-A	Ventura
J. A. Hess	4	3	23	18	Ventura
Shell Co.	28	3	23	Gosnell 10	Ventura
Shell Co.	28	3	23	Gosnell 16	Ventura
Shell Co.	28	3	23	Gosnell 17	Ventura
Shell Co.	28	3	23	Taylor 9	Ventura

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

DEALERS IN GOLD-SILVER ORES AND BULLION MUST TAKE OUT LICENSES.

Senate Bill No. 137, which was passed by the forty-sixth session of the legislature and approved by the Governor, April 15, 1925, became effective July 24, 1925.

This bill is for the regulation and control and licensing of persons, firms or corporations engaged in the business of sampling, concentrating, purchasing or receiving for sale ores, concentrates or amalgams bearing gold and silver, gold dust, silver or gold bullion, nuggets or specimens.

This act will make it necessary for any one dealing in the above mentioned materials to take out a license together with a bond, the license fee being $100 per year and the bond $3,000. The banks, while exempt from paying the license fee, will not be exempted from the provisions of the act and of the bond. Jewelers and pawnbrokers who turn in their sweepings and scrap as is and not melted will be exempted, but those dealing in ores, specimens, nuggets and melted materials will come under the provisions of the act. Others affected by this act are assayers, storekeepers, trustees, referees and others dealing in gold and silver ores, bullion, nuggets and amalgams.

Application blanks for licenses and copies of the law may be had by applying to Lloyd L. Root, State Mineralogist, State Mining Bureau, Ferry Building, San Francisco.

An abstract of the law is as follows:

Section 1.—Provides that it shall be unlawful for any person, firm, association or corporation, without first procuring a license from the state mineralogist, to engage in the business indicated in the above mentioned title. The annual license fee is $100 and will be issued only to bona fide residents of California, and to such corporations organized under the laws of other states as are duly qualified to do business in this state. *Provided, however*, that this act is not to be construed as requiring a license for any mill, sampler, concentration or reduction plant used exclusively by any company or owner in sampling, milling, reducing or concentrating ores produced by such owner.

Section 2.—Provides that the application for license must be made to the state mineralogist accompanied by certain information which must be sworn to by such applicant. Licenses will be granted only after 30 days notice and by publication at least once a week for three successive weeks, at the expense of applicant, in a newspaper published in the county where such business is carried on.

Protests to the granting of licenses, and written charges for the revocation of licenses already issued, may be filed and public hearings held thereon in accordance with prescribed rules, and the state mineralogist shall have the power to reject an application or revoke any license for failure on the part of the applicant or licensee to observe this act or any law of the state relative to larceny or receiving stolen property. Application for a review or appeal to the Superior Court from any decision made by the state mineralogist is also provided for under the provisions of this section.

Section 3.—Provides that each application for a license shall be accompanied by a bond to the people of the State of California in the sum of $3,000, and conditioned that the licensee shall not violate any law applicable to said business. Said bond will be subject to execution upon any judgment recovered against a licensee as the result of his violation of any law relating to such business.

Section 4.—Provides that *every* person, firm, association or corporation engaged in such business shall keep and preserve a book in which shall be entered at the time of delivery of any ores, concentrates or amalgams, bearing gold or silver, gold dust, gold or silver bullion, nuggets or specimens:

First—The name of the party on whose behalf such ores, concentrates, gold dust, gold or silver bullion, nuggets or specimens are delivered;

Second—The weight, or amount, and a short description of each lot thereof;

Third—The name and location of the mine or claim from which it shall be stated that the same has been mined or procured;

Fourth—The name of the party delivering the same;

Fifth—The date of delivery; and

Sixth—Whether the party making the delivery is a lessee, superintendent, foreman or workman in such mine.

Such record book shall be open for inspection at all times to the state mineralogist or his authorized agents, and by permit of the state mineralogist issued to any other person who claims under affidavit to have sustained a loss by theft or trespass of property subject to sale under this act.

Section 5.—Provides that licensees who fail to keep records, as above provided, or who make any false entries or use fictitious names, or fail to permit the inspection of books by authorized persons, shall, upon conviction, forfeit their license and become liable to the penalties hereinafter provided.

Section 6.—Provides that any person who shall make any false statement concerning any facts required in section 4 shall be guilty of a misdemeanor.

Section 7.—Provides that complaints against any licensee shall be made in writing and filed with the state mineralogist. Upon due notice to all interested parties, and after a hearing thereon, the state mineralogist may refuse to issue and shall suspend or revoke any license for any good cause shown.

Section 8.—Provides that any violation of sections 1, 4, and 5 of this act shall be punishable by a fine of not less than $100 and not more than $1,000, or by imprisonment for not less than 30 days or more than 6 months, or by both such fine and imprisonment.

The complete text of the new law follows:

CHAPTER 70.

An act to provide for the regulation, control and licensing of any person, firm or corporation engaging in the business of milling, sampling, concentrating, reducing, purchasing, or receiving for sale ores, concentrates, or amalgams, bearing gold or silver, gold dust, silver or gold bullion, nuggets or specimens; to provide rules and regulations therefor; and to provide penalties for the violation of the provisions of this act.

[Approved April 15, 1925.]

The people of the State of California do enact as follows:

License to handle ores, etc.

SECTION 1. Hereafter it shall be unlawful for any person, firm, association or corporation, without first procuring the license hereinafter provided for, to engage in the business of milling, sampling, concentrating, reducing, purchasing or receiving for sale ores, concentrates, or amalgams, bearing gold or silver, gold dust, gold or silver bullion, nuggets or specimens. Every person, firm, association or corporation engaged in such business shall pay a license tax of one hundred dollars ($100) per annum to the State of California. No license shall be granted to any person, firm or association unless such person and the members of such firm or association shall be bona fide residents of the State of California, and no license shall be granted to any joint stock company or corporation organized under the laws of any other state or foreign country unless such company or corporation has complied with all the laws of this state relating to the qualification of foreign corporations to do business in this state: *provided*, that this section shall not be construed as requiring a license for any mill, sampler, concentration or reduction plant used exclusively by the owner in sampling, milling, reducing or concentrating ores produced by such owner.

Applications for licenses.

SEC. 2. The application for license to carry on such business must be made to the state mineralogist of the State of California, and shall contain the full names and addresses of applicants, if natural persons, and in the case of firms and associations the full names and addresses of the members thereof, and in the case of corporations, the full names and addresses of the officers and directors thereof, and the place or places where such business is to be carried on. Such application shall be sworn to by the person making it. Every license granted shall date from the first day of the month in which it is issued and expire on the thirty-first day of the following December, and such license or copies thereof shall be kept conspicuously displayed in the place or places of business of the licensee within the State of California. Every application shall be filed not less than thirty days prior to the granting of such license, and notice of the filing of such application shall be posted in the office of said state mineralogist and be published at the cost of the applicant once a week

Notice.

for three successive weeks in a newspaper published in the county or counties where such business is to be carried on. Protest may be made by any person to the issuing of such license, and when such protests are filed with the state mineralogist, the latter shall give notice of and hold a public hearing upon said protest before issuing such license. The said state mineralogist shall have the power to reject any application for license after a hearing upon such protest as aforesaid and he shall also have power to revoke any license for failure on the part of the licensee to observe this act or any part thereof, or when the licensee shall have violated the provision or provisions of any law of the State of California relating to ore buying or of any law of said state relating to larceny or receiving stolen property: *provided*, that no license shall be revoked except upon written charges filed by two or more reputable persons as accusers, specifying the violations of law for which revocation is sought, and after a public hearing as in case of protests against the granting of licenses. An application for a review of any order granting, refusing, or revoking a license made by the state mineralogist under this act, may be made to the superior court in and for the county where the aggrieved parties reside, by any person or persons who may feel aggrieved by such order and whose name or names appear in the record of the proceedings before the state mineralogist as a licensee, applicant for license, protestant, or accuser, by lodging in the office of the clerk of said court a certified copy of the transcript of the proceedings before the state mineralogist, including copies of all papers filed therein. The transcript shall be accompanied by a short petition naming the person or persons applying for the review as plaintiff or plaintiffs and the state mineralogist as defendant, and praying for a review of the order.

Protests.

Rejection of applica-tion.

Review of order.

Within ten days after lodging such application the party or parties applying for the review shall serve notice of its pendency upon the state mineralogist, in writing, and if the review be of an order granting a license or refusing to revoke a license, such notice shall also be served upon the person to whom the license was thereby granted or whose license was thereby permitted to remain in force.

Notice of pendency.

Such notice may be served by personal delivery or by registered mail, and proof of service shall be made to the satisfaction of the court if not admitted. No review shall be allowed unless taken within thirty days after entry of the order. The said court shall try all such reviews upon the transcript, and such evidence as may be offered and admitted. When the court has finally determined any such proceeding, it shall forthwith cause its order in the premises to be certified to the state mineralogist. The costs in such review shall be awarded at the discretion of the court, and if any costs are awarded against the state mineralogist, the same shall be paid out of funds arising from the payment of license fees under this act. When a review is had, as herein provided, of an

Hearing.

order of the state mineralogist revoking a license, such review shall operate as a stay upon such order.

For the making of the transcript herein provided for, the state mineralogist shall collect from the person or persons ordering the same, twenty-five cents per folio of one hundred words, and twenty-five cents for certifying the same.

The superior court in and for the county or city and county in which the aggrieved party or parties reside shall have the right and jurisdiction to review the action of the state mineralogist in granting, refusing, or revoking a license.

Bond.

SEC. 3. Each application shall be accompanied by a bond to be approved by the said state mineralogist to the people of the State of California in the penal sum of three thousand dollars ($3000), with two or more sufficient sureties or by a surety company duly authorized to do business in this state, and conditioned that the obligor will not violate any law applicable to such business. If any person shall be aggrieved by the misconduct of any such licensee through his violation of any law relating to such business, and shall recover a judgment therefor, such person may, after a return unsatisfied in whole or in part of any execution issued upon said judgment, maintain an action in his own name upon such bond herein required in any court of competent jurisdiction. The state mineralogist shall furnish to any one applying therefor a certified copy of any such bond filed with him, upon the payment of a fee of twenty-five cents, and such certified copy shall be prima facie evidence in any court that such bond was duly executed and delivered by each person whose name appears thereon. Said bond shall be renewed and refiled prior to the date of its expiration, or the licensee shall, within thirty days thereafter, cease doing business, and his license shall be revoked by said state mineralogist; but said bond until renewed and refiled, shall remain in full force and effect for a period of three years from the time of approval thereof by the state mineralogist.

Actions.

Renewal of bond.

Record of ores handled.

SEC. 4. Every person, firm, association or corporation, carrying on such business, shall keep and preserve a book in which shall be entered at the time of the delivery of any ores, concentrates or amalgams, bearing gold or silver, gold dust, gold or silver bullion, nuggets or specimens:

First—The name of the party on whose behalf such ores, concentrates, gold dust, gold or silver bullion, nuggets or specimens are delivered;

Second—The weight, or amount, and a short description of each lot thereof;

Third—The name and location of the mine or claim from which it shall be stated that the same has been mined or procured;

Fourth—The name of the party delivering the same;

Fifth—The date of delivery; and

Sixth—Whether the party making the delivery is a lessee, superintendent, foreman, or workman in such mine.

Such book shall be open for inspection to the said state mineralogist, his deputies, officers, and agents, on every day except Sundays and legal holidays, between the hours of nine o'clock in the forenoon and five o'clock in the afternoon. If any person, on his own behalf or being duly authorized thereunto by another, shall make and file with the said state mineralogist an affidavit stating that to his best knowledge and belief he or his principals, as the case may be, has, within the three months next preceding the filing of such affidavit, sustained a loss of any of the above described property, by theft or trespass, and that he believes that such property was delivered to a licensee under this act, naming such licensee, the state mineralogist shall forthwith issue a permit to such person to examine the book kept by such licensee under this act; and upon the presentation of such permit to such licensee, such person shall have the right to inspect and examine the entries made in said book during said period of three months, on the same terms and conditions as the state mineralogist. Examination of record.

SEC. 5. Any licensee under this act who shall fail, or neglect or refuse to keep and preserve the book herein provided for, shall forfeit his license and shall in addition, upon conviction, be liable to the penalties provided in section eight of this act. Any licensee or other person who shall knowingly make any false entries upon such book, or knowingly enter or cause to be entered upon the same any false or fictitious names, shall upon conviction, be liable to the penalties provided in section eight of this act. Any licensee who shall refuse to permit any person duly authorized as herein provided to inspect said book or the entries therein, shall, on conviction, be liable to the penalties provided for a violation of this act and shall forfeit his license. Penalties for violation of act.

SEC. 6. Any person who shall knowingly make any false statements concerning any of the facts required to be stated in section four of this act shall be guilty of a misdemeanor. Penalty for false statements.

SEC. 7. Complaints against any licensee or applicant shall be made in writing to said state mineralogist, and reasonable notice thereof, not less than three days, shall be given to said licensee or applicant by serving upon him a copy of such complaint, and a hearing shall be had before the said state mineralogist within one week from the date of the filing of the complaint, and no adjournment shall be taken for longer than one week. A daily calendar shall be kept of all hearings by said state mineralogist, which shall be posted in a conspicuous place in his public office for at least three days before the date of such hearing. The said state mineralogist shall keep a record of all such complaints and hearings, and may refuse to issue and shall suspend or revoke any license for any good cause shown, within the meaning and purpose of this act; and when it is shown that any licensee or applicant under this act, either before or after conviction, is guilty of any conduct in violation of this or any law relating to such business, it shall be the duty of the said state mineralogist of the State of Cali- Complaints, hearings and decisions.

fornia to suspend, revoke or reject the license of such licensee or applicant, but notice of the proposed action shall be presented to and reasonable opportunity shall be given licensee or applicant to be heard in his defense. Whenever for any reason such license is revoked, said state mineralogist shall not issue another license to said licensee until the expiration of at least one year from the date of revocation of such license. The state mineralogist shall decide all matters submitted to him within thirty days from the time he takes them under advisement.

Penalties and their enforcement.

SEC. 8. Any violation of sections one, four, and five of this act shall be punishable by a fine of not less than one hundred ($100) dollars and not more than one thousand ($1,000) dollars, or by imprisonment in the county jail for not less than thirty days or more than six months or both such fine and imprisonment. The said state mineralogist shall notify the district attorney of the county in which the offense occurs of such violation, and the said district attorney shall institute criminal proceedings for the enforcement of this act before any court of competent jurisdiction.

Disposition of funds.

SEC. 9. The expenses of the state mineralogist arising out of this act shall be defrayed out of the moneys paid in from time to time for licenses issued hereunder. Any balance remaining in the hands of said state mineralogist at the end of every six months derived through this act, shall be turned over to the general fund of the state.

Transferal of duties.

SEC. 10. Should the duties of the state mineralogist be transferred to a director or department of mines and mineral resources, all of the powers, rights, duties and responsibilities of the state mineralogist provided in this act shall be thereby transferred to such director or department of mines and mineral resources.

Constitutionality.

SEC. 11. If any section, sentence, clause or phrase of this act is for any reason held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this act. The legislature hereby declares that it would have passed this act and each sentence, clause and phrase thereof, irrespective of the fact that any one or more of the sections, sentences, clauses or phrases be declared unconstitutional.

ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Personnel.

Prof. W. F. Dietrich, of the Department of Mining, Leland Stanford Junior University, has been engaged by the State Mining Bureau under a cooperative arrangement between the two departments to conduct a survey of the clay resources of California. He is making field examinations during the university's summer vacation period.

Effective August 1st, the following transfers of deputy supervisors are announced by the State Oil and Gas Supervisor: Mr. C. C. Thoms from District 1 to District 2 with headquarters at Santa Paula; Mr. Emil Huguenin from District 4 to District 1 with headquarters at Pacific Finance Building, Los Angeles; Mr. H. A. Godde from District 2 to District 4 with headquarters at Taft.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Mining in California (quarterly), April, 1925, being Chapter 2 of State Mineralogist's Report XXI. Price 25 cents.

Summary of Operations, California Oil Fields: Vol. 10, Nos. 7, 8, and 9, January, February, and March, 1925, respectively.

Commercial Mineral Notes: Nos. 26, 27, 28, May-July (inc.). These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale,' issued in the form of a mimeographed sheet, monthly. It is mailed free of charge to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains, in addition to its correspondence file and the library, a mine report file which includes reports on some 7500 mines and mineral properties in California. Also, there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the period covered by this quarterly report, there were 1703 letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics. Museum. Laboratory.

WALTER W. BRADLEY, Deputy State Mineralogist.

STATISTICS.

Data on the 1924 production of several of California's minerals were given in the April issue of MINING IN CALIFORNIA, and some additional ones are presented herein. Copy for the complete annual report for that year is now being prepared and will shortly go to the printer, as Bulletin No. 96 of the State Mining Bureau.

COPPER.

Copper is second only to gold among the metals produced in California. The output for 1924 amounted to a total of 52.089.349 pounds valued at $6.823.704, being nearly double the quantity and approximately a 65% increase in value over the 1923 figures which were 28.346.860 pounds, worth $4.166.989. The increase was due mainly to resumption of operations in Shasta County, but in part also to a larger yield from Calaveras and Plumas counties. The average price in 1924 was 13.1¢ per pound, as against 14.7¢ in 1923, and 13.5¢ in 1922.

Plumas County ranked first for the year, with an output of 25.557.362 pounds; Shasta, second, with 21.109.958 pounds; and Calaveras, third, with 4.724.441 pounds.

Distribution of the 1924 copper output, by counties, was as follows:

Copper Production, by Counties, 1924.

County	Pounds	Value
Calaveras	4,724,441	$618,902
Inyo	79,995	10,479
Madera	34,467	4,515
Plumas	25.557,362	3,348,015
Riverside	8,899	1,166
San Bernardino	17,667	2,314
Shasta	21,109,958	2,765,405
Trinity	550,000	72,050
Alpine, Amador, El Dorado, Kern, Los Angeles, Merced, Mono, Nevada, Orange, Sierra *	6,560	858
Totals	52,089,349	$6,823,704

* Combined to conceal output of a single operator in each.

GOLD.

The production of gold in California in 1924 totaled 636.139.72 fine ounces, worth $13.150.175, being a decrease of 11.070.03 fine ounces from the 1923 yield. As the State Mining Bureau has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Mr. J. M. Hill of the U. S. Bureau of Mines, Department of Commerce (effective July 1, 1925, the former Mineral Resources Division of the U. S. Geological Survey was combined with the Bureau of Mines and tranferred to the Department of Commerce).

The largest gold production for 1924 is reported from Nevada County, with an output of 136.419.04 fine ounces ($2.820.032); Amador County, with 130.927.34 ounces ($2.706.508) was second; followed by Yuba and Sacramento in third and fourth places, respectively. The drop of Yuba County from first place, which it has held recently, was due to a decline in dredge yield.

Distribution of the 1924 gold production, by counties, was as follows:

Gold Production, by Counties, 1924.

County	Value	County	Value
Amador	$2,706,508	Nevada	$2,820,032
Butte	484,530	Placer	108,757
Calaveras	853,961	Plumas	277,571
Del Norte	325	Riverside	1,070
El Dorado	28,207	Sacramento	1,150,687
Fresno	32,978	San Bernardino	187,573
Humboldt	1,269	San Diego	4,830
Imperial	258	Shasta	346,622
Inyo	19,977	Sierra	799,276
Kern	154,132	Siskiyou	63,570
Lassen	2,250	Stanislaus	196,019
Los Angeles	751	Trinity	422,281
Madera	3,208	Tuolumne	255,994
Mariposa	182,099	Yuba	1,995,434
Merced	355		
Mono	49,651	Total	$13,150,175

LEAD.

Lead production in California in 1924 decreased to approximately 50% of the amount shown in the preceding year. The principal output was from silver-lead ores from Inyo County. The total recoverable lead in ores shipped from California mines in 1924 amounted to 4,984,387 pounds valued at $398,751, compared with 9,934,522 pounds and $695,416 in 1923. The average price in 1924 was 8.0¢ as against 7.0¢ in 1923, 5.5¢ in 1922, and 3.9¢ in 1913.

The 1924 production was distributed by counties as follows:

Lead Production, by Counties, 1924.

County	Pounds	Value
Inyo	4,813,718	$385,098
Mono	32,458	2,597
Riverside	26,817	2,145
San Bernardino	31,668	2,533
Shasta	6,615	529
Alpine, Amador, Calaveras, Kern, Los Angeles, Merced, Nevada, Orange *	73,111	5,849
Totals	4,984,387	$398,751

* Combined to conceal output of a single operator in each.

PETROLEUM.

The crude oil production of California for 1924 amounted to a total of 228,933,471 barrels of clean oil, valued at $274,652,874 at the well. This total of quantity is compiled from the monthly production reports filed by the operators with the State Oil and Gas Supervisor, to which have been added figures for the output of a number of small operators in the Los Angeles city field not under the jurisdiction of the Supervisor.

The question of the value of the crude oil yield, at the well, is a difficult one to settle with exactitude, principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil which they send direct from well to plant, hence much of the crude is not sold as such. The values used in the statistical reports of the State Mining Bureau since 1914 have been derived from averages of actual sales of crude oil of all grades in each field of the state, and these averages applied to the total yield of the respective fields. This we feel is a safer measure of commercial values than market quotations, because quotations do not always mean sales.

Features of 1924.

The noteworthy features of the year 1924 in the oil industry of California were the decrease in gusher production in the new fields in the Los Angeles Basin, and the increase in the market value per barrel for crudes. Quantities in Los Angeles and Orange counties decreased, while Fresno, Kern, and Ventura registered material increases. In Fresno and Kern counties, much of the shut-in production was again opened up and drilling activity also resumed. There were two increases in 1924 in prices quoted for crude oil at the well announced by the marketing companies: One, February 5, affecting all grades; and the other, September 24, for high-gravity crude in the new Rosecrans field.

Estimating in January the output of the year just closed, the State Oil and Gas Supervisor[1] presented the following observations:

> "The production of oil in California in 1924 was 230,045,000 barrels, according to statistics of the American Petroleum Institute, including estimates for the month of December. This is 33,683,895 barrels less than was produced in 1923.
>
> "An analysis of the increases and decreases in the various parts of the State is of value in showing the effect of decline just following the flush period of some fields, partly offset by the development of new fields and the resumption of closed-in production in some of the older fields.
>
> "The greatest declines were in the Santa Fe Springs, Huntington Beach and Long Beach fields, which produced 78,964,000 barrels less in 1924 than in 1923, distributed as follows: Santa Fe Springs, 53,385,000; Huntington Beach, 16,863,000; Long Beach, 8,716,000.
>
> "The decline was partly offset by an increase of 45,283,000 barrels in other fields, the fields of the San Joaquin Valley producing 19,677,000 barrels more in 1924, both from new wells and from wells shut down during all or part of 1923; Torrance and the new fields Dominguez and Rosecrans contributing increased production as follows: Torrance 14,377,000 barrels, Dominguez 6,623,000 barrels, Rosecrans 620,000 barrels; the Coyote Hills field, practically shut down during part of 1923, contributing 3,206,000 barrels more in 1924 than in 1923; and miscellaneous 780,000 barrels."

Outlook for 1925.

It is difficult to predict, as yet, for 1925. Lacking the opening up of any new field, it appears thus far that the output for the current year will probably be less in total quantity than the year 1924, due largely to the decline in the Los Angeles Basin fields.

Production Figures.

The following table gives the production and value by counties for 1924, compared with the 1923 figures:

Production and Value of Crude Oil, by Counties.

	1923		1924	
County	Barrels	Value	Barrels	Value
Fresno	5,061,542	$3,593,695	10,156,405	$11,801,743
Kern	45,952,794	37,629,300	61,175,405	69,572,934
Los Angeles	158,665,019	154,063,733	119,027,428	147,474,953
Orange	46,474,921	40,897,930	31,661,283	37,455,298
San Luis Obispo	32,988	19,793	31,222	30,972
Santa Barbara	3,061,947	2,394,433	2,905,181	3,009,768
Santa Clara			14,417	20,481
Ventura	3,610,794	4,109,084	3,958,010	5,279,985
San Mateo and Santa Clara[a]	15,685	23,341	--------	--------
San Bernardino and San Mateo[b]	--------	--------	4,120	6,740
Totals	262,875,690	$242,731,309	228,933,471	$274,652,874

[a] Combined to conceal output of a single operator in San Mateo County.
[b] Combined to conceal output of a single operator in each.

The foregoing totals show a state average price of $1.200 per barrel for the year 1924, as compared to $0.923 in 1923 and $1.249 in 1922.

---

[1] Bush, R. D., Weekly press bulletin, No. 481: Dept. of Petr. and Gas; Cal. State Min. Bur., Jan. 10, 1925.

Oil in 'Storage.'

Field, refinery, pipe-line, and tank-farm stocks of crude and refinery products in Pacific Coast territory totaled 125,021,964 barrels,[1] December 31, 1924, compared with 116,727,442 barrels on December 31, 1923, distributed as follows:

Stocks	Dec. 31, 1924 (Barrels)	Dec. 31, 1923 (Barrels)
Heavy Crude, heavier than 20° A. P. I., including all grades of fuel	57,254,796	52,393,302
Refined Crude, 20° A. P. I., and lighter	40,574,578	36,880,942
Gasoline	10,957,487	7,696,815
Naphtha distillates	9,396,613	13,114,490
All other stocks	6,838,490	6,641,893
Total all stocks	125,021,964	116,727,442

Beginning with September, 1924, the American Petroleum Institute in reporting 'stocks' and 'storage' expanded their figures to include "stocks of all products held by the principal marketing companies at all points in all the Pacific coast territory including British Columbia, Alaska, and Hawaii." Hence, the above tabulation is not comparable with the figures shown in our previous statistical reports which showed stocks in California only.

Proved Oil Land.

The total proved oil land of the state increased to 118,979 acres in 1924, as against 116,868 acres in 1923. Of this 1924 total, 21,556 acres being owned by federal, state, and city governments, or for other reasons, is not assessable for the support of the Department of Petroleum and Gas of the State Mining Bureau. The acreage in 1924 was distributed by counties, as follows:

Proved Oil Land and Number of Wells, 1924.

County	Land (acres)	Number wells
Fresno	14,646	1,105
Kern	74,270	6,015
Los Angeles *	10,763	2,212
Orange	6,902	1,082
San Bernardino	----	1
San Luis Obispo	402	19
San Mateo	----	4
Santa Barbara	7,813	377
Santa Clara	80	12
Ventura	4,103	529
Totals	118,979	11,356

* Not including the old Los Angeles City Field.

SILVER.

Except for the early-day production of the silver mines of the Calico district and the more recent production from those of the Randsburg district (both being in San Bernardino County), the recovery of silver in California has been largely as a by-product from its association with copper, lead, zinc, and gold ores.

The 1924 silver output of California totaled 3,555,153 fine ounces, valued at $2,381,952, compared with 3,559,443 fine ounces and $2,918,743 in 1923. The average price of domestic silver during 1924 was 67¢ per ounce at New York, as against 82¢ in 1924, and $1.00 in 1921–1923 under the Pittman Act. The figures below are those of the U. S. Bureau of Mines, Department of Commerce (as explained under

---

[1] Standard Oil Bulletin, February, 1925, p. 13.

Gold), to which has been added a small figure from Alpine County not included by that bureau, being less than $100.

The distribution of the 1924 silver yield, by counties, was as follows:

Silver Production, by Counties, 1924.

County	Fine ounces	Value
Amador	27,240	$18,251
Butte	3,161	2,118
Calaveras	11,139	7,463
El Dorado	228	153
Fresno	283	190
Humboldt	10	7
Imperial	2	1
Inyo	172,834	115,799
Kern	53,585	35,902
Lassen	65	44
Los Angeles	8,232	5,515
Madera	262	176
Mariposa	2,400	1,608
Merced	2	1
Mono	9,660	6,472
Nevada	58,585	39,252
Placer	797	534
Plumas	369,506	247,569
Riverside	867	581
Sacramento	2,617	1,753
San Bernardino	2,285,967	1,531,598
San Diego	145	97
Shasta	512,541	343,402
Sierra	7,758	5,198
Siskiyou	442	296
Stanislaus	1,154	773
Trinity	16,320	10,934
Tuolumne	1,651	1,106
Yuba	6,658	4,461
Alpine and Orange *	1,042	698
Totals	3,555,153	$2,381,952

* Combined to conceal output of a single operator in each.

ZINC.

Recoverable zinc in ores mined in California in 1924 amounted to 3,060,000 pounds, valued at $198,900, and was marketed entirely in the form of the oxide. The average price per pound quoted for the metal in 1924 was 6.5¢. There was no recoverable zinc mined in California in 1923.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America: and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign counties as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors, as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

FRANK L. SANBORN, Mineral Technologist.

The price of antimony continues to be such that deposits containing good ores of this metal can be profitably worked. It has been claimed by producers of California antimony that the metal could not be mined at a profit unless the price was above 12¢ per pound. The present antimony price of about 16¢ per pound should make it possible to profitably mine this metal in California.

The occurrence of antimony has been noted in many of the counties of the state, but Kern, Inyo and San Benito were the chief producers during 1916 when the price was also high. Large deposits of antimony are said to occur in the Panamint Mountains in the vicinity of Wild Rose Springs, and in the Argus Mountains. Mono and Alpine counties may also have good deposits of antimony.

The Bureau received 1263 samples for identification during the three-month period covered by this report. Samples were received from practically every county in the state.

LIBRARY.

FOREST L. CAMPBELL, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

- U. S. Geological Survey:
  - Professional Paper No. 132—Shorter contributions to General Geology, 1923–1924. By W. S. Mendenhall.
  - Professional Paper No. 132-I—Origin of the Boghead Coals. By Reinhardt Theissen.
  - Professional Paper No. 132-J—Aniakchak Crater, Alaska Peninsula. By W. R. Smith.
  - Mineral Resources of the United States:
    - Sulphur and Pyrites in 1924.
    - Gold, Silver and Copper in South Dakota and Wyoming in 1923.
    - Gold, Silver, Copper, Lead and Zinc in Nevada in 1923.
    - Gold, Silver, Copper, Lead and Zinc in Utah in 1923.
    - Gold, Silver, Copper, Lead and Zinc in Washington in 1923.
    - Gold and Silver in 1923.
    - Natural Gas in 1923.
  - Bulletin No. 757—Geology and Coal Resources of the Axial and Butte Quadrangles, Moffat County, Colo. By E. T. Hancock.
  - Bulletin No. 772—A Reconnaissance of the Point Barrow Region, Alaska. By Sidney Paige.
  - Bulletin No. 750—Contributions to Economic Geology, Part I—Metals and Nonmetals Except Fuels.
  - Bulletin No. 763—Geology and Ore Deposits of the Arapaipa and Stanley Mining Districts, Graham County, Ariz. By C. P. Ross.
  - Bulletin No. 759—Geology of the Bristol Quadrangle, Creek Co., Oklahoma. By A. E. Fath.
  - Bulletin No. 760-D—Pedestal Rocks in Stream Channels. By K. Bryan.
  - Bulletin No. 760-C—Erosion by Solution and Fill. By W. T. Lee.

- Bulletin No. 773-B—Mineral Investigations in Southeastern Alaska.
- Bulletin No. 773-C—The Occurrence of Copper on Prince William Sound, Alaska. By F. D. Moffit.
- Bulletin No. 773-A—Alaska's Mineral Resources and Production in 1923. By A. H. Brooks.
- Bulletin No. 751—Contributions to Economic Geology, 1923–1924. Part II. Mineral Fuels.
- Water Supply Paper No. 509—Colorado River Basin.
- Water Supply Paper No. 537—A Study of Coastal Ground Water with special reference to Connecticut. By J. S. Brown.
- Water Supply Paper No. 560-B—Chemical Character of Ground Waters of the Northern Great Plains. By H. B. Riffenburg.
- Water Supply Paper No. 560-C—Index of Analysis of Natural Waters in the United States. By W. D. Collins.
- Water Supply Paper No. 520-F—Temperature of Water Available for Industrial Use in the United States. By W. D. Collins.
- Water Supply Paper No. 520-G—Some Floods in the Rocky Mountain Region. By R. Follansbee and P. V. Hodges.
- Water Supply Paper No. 523—Part III—Ohio River Basin.
- Water Supply Paper No. 536—Surface Water Supply of the New-Kanawha River Basin.
- Water Supply Paper No. 539—Geology and Ground Water Resources of Townsend Valley, Montana. By J. T. Pardee.
- Water Supply Paper No. 531—Surface Water Supply of the United States, Part XI—Pacific Slope Basins in California.

U. S. Bureau of Mines:

- Bulletin No. 224—Surface Machinery and Methods for Oil Well Pumping. By H. C. George.
- Bulletin No. 248—Metal Mine Accidents in the United States in 1923.
- Bulletin No. 246—Quarry Accidents in the United States in 1923.
- Bulletin No. 233—Protection of Oil and Gas Equipment against Corrosion. By R. Van A. Mills.
- Bulletin No. 226—The Treatment of Manganese-Silver Ores. By G. H. Clevenger.
- Bulletin No. 251—Coal Mine Fatalities in the United States in 1924.
- Bulletin No. 234—Screen Sizing of Coal, Ores and Other Minerals. By E. A. Holbrook.
- Technical Paper No. 374—Accidents at Metallurgical Works in the United States in 1923.
- Technical Paper No. 357—A Critical Study of the Burrell Indicator for Combustible Gases in Air. By L. H. Milligan.
- Technical Paper No. 360—Vapor Pressures of the Common Metallic Chlorides. By C. G. Maier.
- Technical Paper No. 345—Analyses of Utah Coals.
- Technical Paper No. 341—Metallurgical Treatment of Zinc-retort Residues. By B. M. O'Harra.
- Technical Paper No. 335—Bituminous Coal as Generator Fuel for Large Water Gas Sets with Waste Heat Boilers. By W. A. Dunkley.
- Reports of Investigation:
  - Serial No. 2681—Explosives Used in February, 1925. By W. W. Adams.
  - Serial No. 2682—Line Radio and the Effects of Metallic Conductors on Underground Communication. By J. J. Jakosky and D. H. Zellers.
  - Serial No. 2683—The Formation of Oil-Field Emulsions. By D. B. Dow.
  - Serial No. 2684—Coal-Mine Fatalities in March, 1925. By W. W. Adams.
  - Serial No. 2685—Bibliography on Economic Utilization of Mine Timber. By H. E. Tufft and R. R. Hornor.
  - Serial No. 2686—A Convenient Method for Determining Gum-Forming Material in Gasoline. M. B. Cooke.
  - Serial No. 2687—Explosives used in March, 1925. W. W. Adams.
  - Serial No. 2688—Methods Used for Dehydration of Oil-Field Emulsions. D. B. Dow.
  - Serial No. 2689—Coal-Mine Fatalities in April, 1925. W. W. Adams.
  - Serial No. 2690—Consumption of Explosives in April, 1925. By W. W. Adams.
  - Serial No. 2691—Recent Developments in the Production and Consumption of Abrasive Garnet. By W. M. Myers and C. O. Anderson.

Serial No. 2692—The Physical Chemisty of Oil-Field Emulsions. By D. B. Dow and C. E. Reistle, Jr.

U. S. Department of Commerce:
  Simplified Practice Recommendation No. 14—"Roofing Slate."
  Bureau of Standards:
    Technologic Paper No. 262—Comparison of American and Foreign Clays as Paper Fillers. By Merle B. Shaw.
    Circular No. 100—Nickel and Its Alloys.
    Circular No. 151—Wall Plaster; Its Ingredients, Preparation and Properties.
    Scientific Paper No. 483—Investigation on the Platinum Metals.
U. S. Department of Agriculture. Miscellaneous Circular No. 39—Report of the National Conference on Utilization of Forest Products.
U. S. National Museum, Proceedings of—Vol. 64.
Alabama, Geological Survey of:
  Bulletin No. 30—Supplemental List of Economic Minerals and Rocks of Alabama. By W. B. Jones.
  Mineral Industries of Alabama. By E. A. Smith.
  Special Report No. 13—Rock Asphalt of Alabama and Their Use in Paving. By G. H. Clark.
California, Department of Public Works, Biennial Report of the Division of Water Rights.
Florida Geological Survey—16th Annual Report.
Georgia, Geological Survey of—Bulletin No. 42—Physical Geography of Georgia. By L. La Forge.
Idaho Bureau of Mines and Geology—Pamphlet No. 13—A Geologic Reconnaissance of the Mineral and Cuddy Mountain Mining District, Washington and Adams Counties, Idaho. By D. C. Livingstone.
  Twenty-sixth Annual Report of the Mineral Industry in Idaho for the year 1924. By Stewart Campbell, Inspector of Mines.
  Reprint No. 1—Phosphate Deposits of Idaho and Their Relation to the World Supply. By V. D. Kirkham.
  Bulletin No. 8—Geology and Oil Possibilities of Bingham, Bonneville and Caribou Counties, Idaho. By V. D. Kirkham.
  Bulletin No. 9—Geology and Gold Resources of Boise Basin, Boise County, Idaho. By S. M. Ballard.
  Bulletin No. 10—Geology and Gold Resources of North Central Idaho. By F. A. Thomson.
Illinois Geological Survey:
  Report of Investigations, No. 2—Structure of Parts of Northeastern Williamson and Western Saline Counties. By Gilbert H. Cady.
  Report of Investigations, No. 3—Structure of Herrin (No. 6) Coal Seam near Duguoin. By D. J. Fisher.
  Report of Investigations, No. 4—Carbon Ratios and Petroleum in Illinois. By G. F. Moulton.
  Bulletin No. 46—Limestone Resources of Illinois. By J. E. Lamar and Frank Krey.
Iowa Geological Survey—Vol. XXX—Annual Report, 1921–1922, with Accompanying papers.
Kentucky Geological Survey—Wild Life in Kentucky. By W. D. Funkhauser.
Missouri Bureau of Mines and Geology:
  Biennial Report of the State Geologist for the Period Ending Jan. 1, 1925.
  Vol. XVIII—Structural Reconnaissance of the Mississippi Valley Area from Old Monroe, Mo., to Nauvoo, Ill. By Frank Krey.
New Jersey, Department of Conservation and Development—Annual Report for the years ending June 30, 1922 and 1923.
North Dakota Geological Survey—Bulletin No. 4—The Lignite Deposits of North Dakota. By A. G. Leonard.
Ohio Geological Survey—Bulletin No. 28—Geology of Columbiana County. By Wilber Stout.
South Dakota Geological and Natural History Survey:
  Circular No. 20—The Possibilities of Oil in Western Zieback County. By W. L. Russell.
  Circular No. 22—Structures in Northern Haakon Co. By F. Ward.
  Circular No. 23—Oil and Gas Possibilities in Northern Meade County. By Roy A. Wilson.
  The Biennial Report of the State Geologist, 1922–1924.

- Thirty-fourth Report of the State Mine Inspector for the State of South Dakota.
- Vermont. Report of the State Geologist on the Geology and Mineral Industries of, 1923-1924.
- Wisconsin Geological Survey—Bulletin No. 57—Phytoplankton of the Inland Lakes of Wisconsin. By G. M. Smith.
- Argentina. Ministerio de Agricultura:
  - Publicacion No. 1—Contribucion al Estudio de las Aguas Termo Minerales de Puente del Inca.
  - Publicacion No. 2—Nuevas Observaciones en La Parte Oriental del Neuquen y en el Territorio del Rio Negro.
  - Publicacion No. 3—Estadistica Minera de la Nacion en 1919.
  - Publicacion No. 1—Contribucion a la Paleontologia del Jurasica Sud Americana.
- South Australia—Annual Report of the Director of Mines and Government Geologist for 1923.
  - Geological Survey of South Australia—Bulletin No. 11—Some Developments in Shallow Water Areas in the North East of South Australia. By R. Lockhart Jack.
- Western Australia—Annual Report of the Geological Survey for the year 1923.
- New South Wales Legislative Assembly—Annual Report of the Department of Mines for the year 1924.
- Quebec Department of Colonization, Mines and Fisheries—Report on Mining Operations in the Province of Quebec During the Year 1924.
- Ontario Department of Mines—33rd Annual Report of the Ontario Dept. of Mines.
- Dominion Fuel Board—The Smoky River Coal Field. By James McEvoy.
- Canada Department of Mines:
  - Investigations in Ceramics and Road Materials, 1923.
  - Investigations of Mineral Resources and the Mining Industry, 1923.
  - Investigations of Fuels and Fuel Testing, 1923.
  - Investigations in Ore Dressing and Metallurgy, 1923.
  - Bulletin No. 39—Color Printing of Geological Maps. By C. Senecal.
- Finland. Commission Geologique de:
  - No. 68—Jordskredet I Jaarila. By V. Tanner.
  - No. 71—Om Diabasgangar I Mellerstra. Finland. By W. W. Wiilkinan.
  - No. 70—The Average Composition of the Earth's Crust in Finland. By J. J. Sederholm.
- Great Britain. Geological Survey of:
  - The Geology of North London. By C. N. E. Bromhead.
  - The Geology of the Country around Marlborough. By H. J. White.
- Japan Imperial Geological Survey:
  - Report 91—Magnetite Sand in Ono-mura in the Prefecture of Iwate. By Yozo Okamura.
  - Report 92—Annual Report for the Year Ending March 31, 1924.
  - Industrial Mineral Survey Report—20-21 and 22.
- Mexico Departamento de Minas—Anuario de Estadistica Minera Correspondiente al Año de 1923.
- Boletin de Museo Nacional de Rio de Janiero, No. 4—Maio.
- Spain—Memorias de la Real Academia de Ciencias y Arts—Vol. XVIII. Num. 17 to 23.
- Transvaal Chamber of Mines—Reports of the Executive Committee, Gold Producers Committee and the Colleries Committee for 1924.
- California, University of, Department of Geology:
  - The San Onofre Breccia, Its Nature and Origin. By A. O. Woodward.
  - Notes on the Genus Venericardia from the Eocene of the West Coast of North America. By Marcus A. Hanna.
  - Avidauna of the McKittrick Pleistocene. By Loye Miller.
- Minnesota. University of—Mining Directory of Minnesota, 1925.
- Minesota School of Mines Experiment Station:
  - Bulletin No. 1—Iron Mining in Minnesota. By C. E. van Barneveld.
  - Bulletin No. 2—Preliminary Concentration Tests of Mesabi Ores. By W. R. Appleby.
  - Bulletin No. 3—Preliminary Concentration Tests on Cuyuna Ores. By W. R. Appleby.
  - Bulletin No. 4—Bibliography of Minnesota Mining and Geology. By Winifred Gregory.
  - Bulletin No. 5—Manganiferous Iron Ores of the Cuyuna District. By Edmund Newton.

Bulletin No. 7—The Future of the Lake Superior District as an Iron Ore Producer. By E. W. Davis.
Bulletin No. 9—Magnetic Concentration of Iron Ore. By E. W. Davis.
Missouri, University of—Mechanical Underground Loading in Metal Mines. By C. E. Van Barnefeld.
California Academy of Sciences—Fauna and Stratigraphic Relations of the Tejon Eocene at the Type Locality in Kern County, Cal.
Philadelphia, Academy of Natural Sciences of—Yearbook for the year ending December 31, 1924.
Field Museum of Natural History—Publication No. 227. Annual Report of the Director to the Board of Trustees for 1924.
Tohoku Imperial University, Sendai, Japan—Science Reports, Vol. II, No. 3.
Waseda University, Tokyo, Japan—Memoirs of the College of Science and Engineering, No. 2, 1925.

Books.

The Ore Magmas. By J. E. Spurr.
The American Society of Mechanical Engineers—The Engineering Index for 1924.

Topographic Maps.

Alexis, Ill.
Arcade, N. Y.
Casa Grande, Ariz.
Denver Mountain Parks, Colo.
Divernon, Ill.
Du Bois, Pa.
Elkhead Creek, Colo.
Ellicottville, N. Y.
Franklinville, N. Y.
Inglewood, Cal.
*Kingwood, W. Va.
Molokai, Hawaii.
Hanford, Cal.
Goshen, Cal.
*Morgantown, W. Va.-Pa.
Perryville, Mo.
Petronilla, Tex.
Reelfoot Lake, Tenn.-Mo.-Ky.
Scooteney Lake, Wash.
Signal Peak, Ariz.
Springville, N. Y.
Standard Symbols.
Stoddartsville, Pa.
Venice, Cal.
Watts, Cal.
Winston, Mo.
Lemoore, Cal.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Bulletin, Union Oil Co., Los Angeles.
California Journal of Development, San Francisco.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical Engineering and Mining Review, London, England.
Engineering and Mining Journal-Press, New York.
Explosives Engineer, Wilmington, Del.
Financial Insurance News, Los Angeles, California.
Graphite, Jersey City.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mine and Quarry, Chicago.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil and Gas News, Kansas City.
Oil News, Galesburg, Illinois.
Oildom, New York.

---

* New edition.

Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, Sacramento, Cal., and Unionville, Nev.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

31-14 Foreman, assayer, etc., at small mine. Ten years' experience as timber man, foreman, superintendent. Can run stamp mill, compressors, gas engines, motors, etc. Age 45. Married. Salary open. References.

31-15 Superintendent of coal mine. Fifteen years' experience as coal mine manager. Age 42, married. Salary open. References.

31-16 Geological exploration. Twenty years' experience foreign and U. S., as mining engineer, manager, etc., in platinum, gold and coal fields. Russian, speaks good English. Age 39, single. Salary open. References.

31-17 Mining engineer. One year's experience. Age 26, married. Salary wanted, $175. References.

31-18 Analytical and metallurgical chemist. Technical graduate. Twelve years' experience research, testing and analytical work. Accustomed to various engineering plants. Age 38, married. Will consider minimum of $200. Reference.

31-19 Draftsman. Eight years' experience, shipbuilding, electric, petroleum and highway lines. Age 33, single. References. Salary wanted, $175.

31-20 Field Exploration. Forty years' experience in prospecting, etc. Wants grubstake contract, expenses and interest in whatever is found. Will not leave U. S. Age 65. Single. References.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; Pacific Finance Building, Los Angeles; in Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	---
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper	.50
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper	.50
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65
Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	3.75
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of State Mineralogist, Mining in California. Lloyd L. Root. Published quarterly. January, April, 1925, per copy	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924	Free
January, February, March, April, 1925	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps	$0.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	.25

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted	$2.50
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring. 1918. 248 pp., 51 illustrations, 5 maps, paper	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California. (In press.)	----
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916–1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917–1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	----
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth	1.00
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley, 1923	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley, 1924	Free
Bulletin No. 95. Geology and Ore Deposits of the Randsburg Quadrangle. (In press.)	----

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----

PRELIMINARY REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	----
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free
Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper	Free
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----

MAPS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County	---
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County	----
Register of Oil Wells, with Map, Los Angeles City	----

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California, Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted	$0.50
**Unmounted	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	.25
**Map of Trinity County	----
Map of Tuolumne County	.25
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County	.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emido and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75

OIL FIELD MAPS—Continued.

	Price
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	$0.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	1.00
Map No. 30—Rosecrans, Los Angeles County	1.00

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

O

40519 9-25 2750

THE STATE MINING BUREAU

CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE

MINERAL RESOURCES OF CALIFORNIA

At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the State Mineralogist, as well as of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily.
Saturday, 9 a.m. to 12 m.

LLOYD L. ROOT,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.

Branch Offices: Pacific Finance Building, Los Angeles; Chamber of Commerce Building, Sacramento, Bakersfield, Taft, Coalinga Santa Maria and Santa Paula.

Mining in California

OCTOBER, 1925

PUBLISHED QUARTERLY

CALIFORNIA STATE
MINING BUREAU

FERRY BUILDING
SAN FRANCISCO

CALIFORNIA STATE MINING BUREAU.

EXECUTIVE AND TECHNICAL STAFF

LLOYD L. ROOT
State Mineralogist

WALTER W. BRADLEY
Deputy State Mineralogist

MINING DIVISION

C. A. Logan, District Mining Engineer	Sacramento
C. McK. Laizure, District Mining Engineer	San Francisco
W. Burling Tucker, District Mining Engineer	Los Angeles
Frank Sanborn, Mineral Technologist	San Francisco
W. F. Dietrich, Ceramic Engineer	San Francisco

DEPARTMENT OF PETROLEUM AND GAS

R. D. Bush, State Oil and Gas Supervisor	San Francisco

Note.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT State Mineralogist

Vol. 21 OCTOBER, 1925 No. 4

CHAPTER OF

REPORT XXI OF THE STATE MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1925

CONTENTS.

Page

DISTRICT REPORTS OF MINING ENGINEERS 413

Sacramento Field Division 413

Siskiyou County 413

San Francisco Field Division 499

San Luis Obispo County 499

Los Angeles Field Division 539

Santa Barbara County 539

Oil Field Development Operations 563

SPECIAL ARTICLES 568

Directory of California Foundries 568

ADMINISTRATION DIVISION 573

DIVISION OF MINERALS AND STATISTICS 574

Statistics 574

Museum 588

Laboratory 588

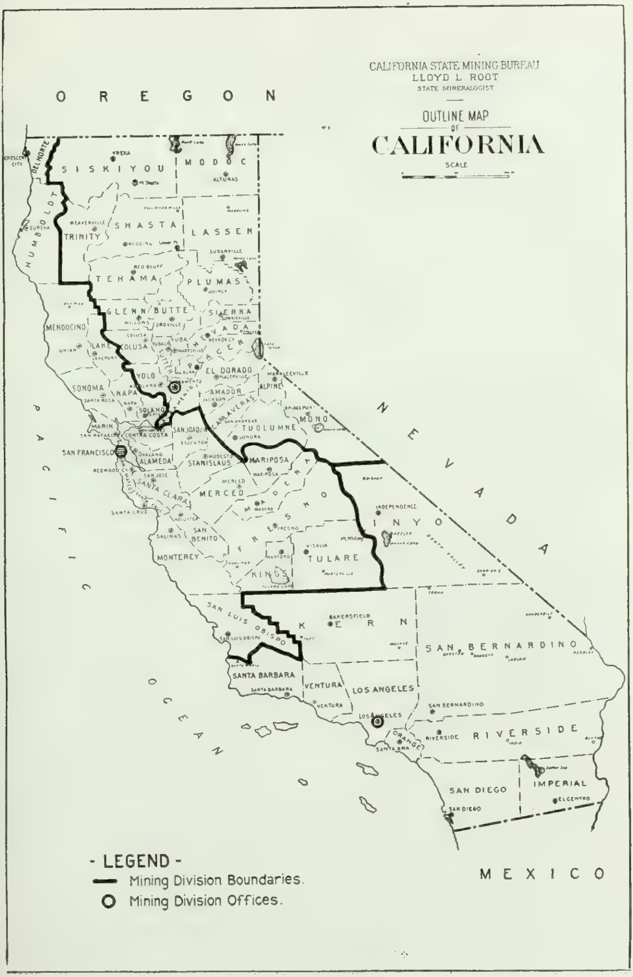
LIBRARY 589

PRODUCERS AND CONSUMERS 594

EMPLOYMENT SERVICE 595

BUREAU PUBLICATIONS I

INDEX 597



CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST

OUTLINE MAP
OF
CALIFORNIA

PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

SISKIYOU COUNTY.

Foreword and Acknowledgment.

The following report is based upon field work carried on from July to November, 1925, during which time the mines of Trinity County were also visited and there were numerous interruptions necessitated by routine office work.

The aim of the present season's work was to cover all mining activity not heretofore accurately recorded in the Bureau's reports, and to present a comprehensive idea in one report of the county's mineral resources. It would be physically impossible for an engineer to visit all prospects in this county in a year's time, spending every day in the field, as the mineralized area is too extensive and traveling is necessarily slow in such rugged country. At the same time, detailed notes are presented on many properties not previously described, the idea being to supply details of geology for a number of properties that may serve as types, and avoid repetition of similar details for numerous mines of the same kind. That a certain property is covered in considerable detail herein, while a neighboring property of apparently equal interest receives less space, is due to the fact that in the first case the writer may have received better co-operation from owners, or accidental circumstances, arising at the time of visit may have made it possible to cover one in greater detail than another. The sparsely settled condition of the mining sections (there being often only one inhabitant in many square miles) and the number of nonresident owners, increase the difficulty of getting accurate details. It should also be noted that since few of the mines and prospects are patented, and fewer still are carried on the real property tax rolls, the ownership and other details regarding many idle properties were not obtainable with absolute certainty in the time available.

The writer wishes to acknowledge with thanks the assistance rendered by many local miners and property owners, particularly Messrs. H. C. Cutting, M. J. Conover, W. J. Brown and the late Reeves Davis, all of Happy Camp; Frank and Dave Morgan, Gottville; J. V. McTimmonds and Joe Martin, Seiad Valley; H. J. Barton, Yreka; E. W. Morgan, Oak Bar; C. B. Kay, Ager; L. J. Joubert, A. J. Ball, E. Jacquemart, Judge Judin Johnson, Ike Cleaver and others of Sawyers Bar; Scott Howard of Sacramento, and numerous others who cooperated by supplying valuable information.

A bibliography of publications on the mineral resources and geology of this county will be found at the end of the report.

Geography.

Siskiyou County, one of the northernmost in the state, borders on the state of Oregon for a distance of 116 miles and is from 60 to 70 miles long, being bounded on the west by the coast counties of Humboldt and Del Norte, on the south by Trinity and Shasta, and on the east by Modoc. The region of interest to the miner is the portion lying west of the lava sheet, the western boundary of which coincides roughly with the Oregon branch of the Southern Pacific Railroad, traversing the county from north to south a little east of its center. The total area of the county is 6256 square miles and the population of 18,500 is concentrated almost entirely along the railroad, at the county seat, and in Scott Valley.

The western mineral-bearing section is a succession of high mountains and deep canyons, forming the drainage basin of Klamath River and its tributaries. The Klamath follows a crooked westerly course across the northern part of the county, receiving Shasta and Scott rivers, the principal streams draining the central part of the county; then turning south near Happy Camp where Indian Creek enters, it flows through a deep canyon, receiving the waters of Salmon River at Somes Bar on the southwest county line. The only level land in this region is in Scott Valley, lying at an elevation of 3000 feet along the middle course of Scott River; a few gravel bars along the Klamath River between

Hornbrook and Happy Camp, and such small valleys as those at the mouths of Seiad and Indian creeks, which accommodate the settlements of Seiad and Happy Camp.

Until recently, the more remote mining districts have been handicapped by lack of roads. The Klamath River road from Hamburg Bar to Orleans has only lately been completed. The Salmon River country has had only one outlet up to the present year, and that is normally closed by snow from November to April. Late in 1925, however, a new road, built by the United States government, was completed from Forks of Salmon to the Klamath River road at Somes Bar, and when the balance of the road from Martins Ferry to the coast is improved, this will make both districts accessible all the year, this latter section being difficult and muddy in wet weather where it crosses Humboldt County. The older districts are all reached by fairly good roads. Callahan is 41 miles from Yreka and the same distance from Gazelle. Quartz Valley is 30 miles from Yreka, and Scott Bar is 48 miles from the county seat via Fort Jones or 44 miles via the Klamath River road. Cottonwood and Humbug are only a few miles west of the Pacific highway. The mines near the Klamath River as far west as Oak Bar are reached by the well improved section of highway forming the easterly 30 miles of the Klamath River road.

The most active mining districts at present are the Salmon River country, and the region tributary to the Klamath River from Hornbrook to Cottage Grove. These are discussed more fully in separate paragraphs.

GEOLOGY AND MINERAL RESOURCES.

The county has been celebrated in the past particularly because of its placer mines. Geologically these placer deposits differ from those in the east-central part of the state. In northwestern California the ancient auriferous gravels most actively mined are found in the form of a succession of terrace or bench deposits left at successively lower levels on the sides of the present river canyons as the streams cut downward to their present beds. The flows of lava and volcanic mud, which occurred in the Sierra Nevada during the Tertiary, and which preserved for the modern miner the ancient river channels, are lacking in this region. The terrace deposits of Siskiyou and adjacent counties date from Quaternary to Recent time. They parallel the present streams and have practically the same grades, and such earth movements as have occurred since their deposition have been probably slow and widespread, tending to rejuvenate the streams and accelerate their powers of erosion. The downward cutting rivers enriched their gravels by erosion of the ancient gold-bearing schists and the pre-existing river and shore gravels of the 'Cretaceous Island' of northern California. This Cretaceous island embraced practically all of western Siskiyou County, this area having been elevated above the sea since very early ages, and being devoid of Cretaceous or later marine sedimentary rocks west of the vicinity of Cottonwood Creek. The chief tributaries which themselves have been the scene of placer mining and have contributed gold to the Klamath, are Scott River, Salmon River, tributaries of Shasta River, and Humbug Creek, all entering from the south, and Indian, Beaver and Cottonwood creeks from the north.

Scott River Region.

On Scott River early day placer mining camps flourished on the South Fork around Callahan and at Scott Bar, 3 to 4 miles from the mouth of the main stream. There is still considerable unworked gravel near Callahan. (See under dredging.) This is characterized by lack of grade and dump, and heavy boulders in places. The small area at Scott Bar was extremely rich. There remains quite an area of placer ground at the Roxbury Mine, and some high ground on both sides of Scott River, similar to the Quartz Hill diggings, where auriferous seams and veins of quartz are being worked by the hydraulic process. This seam belt has been considered responsible for the enrichment of the river below its crossing. It is noteworthy that from Callahan to Scott Bar the river itself has yielded little gold, but considerable profitable mining has been done in Quartz Valley, an arm of Scott Valley west of the present river. The gold on the west side of this valley was derived from an ancient channel, probably of Scott River, remnants of which are to be seen at Little Sniktaw Valley, and it can be traced southeastward upstream past Shackelford and Mill creeks, the Pinery workings (formerly Stockton Gravel Mining Company) and old Etna Mills. In places this channel has been entirely eroded into the valley, but elsewhere it is in place and has been worked on a small scale only, because of lack of water. It is a large channel with rather heavy, tight wash. Another class of deposit mined here was derived from local erosion of auriferous seams and small veins in the hills separating Quartz Valley from Oro Fino and Scott Valley. Quartz Valley has interesting possibilities for placer mining yet, but as the ground mentioned near its lower end has not been tested, it is not known whether it could be dredged, or would have to be worked by drifting. The ground is probably quite deep.

North Central Region.

Humbug district, northwest of Yreka and south of Klamath River; Cottonwood district, north of the Klamath, and quartz properties in the vicinities of Yreka, Fort Jones, Cherry Creek and other small quartz and pocket mining districts, may all be grouped together geologically. They occupy an area of 'Paleozoic Metamorphics' which includes very old rocks, the youngest of which may be Carboniferous and the oldest Cambrian, but which can not be definitely placed in the geologic column because of a lack of fossils. Both the igneous and originally sedimentary members of this 'catch-all' classification have been altered. Limestone, slate, some jasper, quartz porphyry, diorite, diabase, hornblende schists, and great masses of serpentine occur. The Paleozoic metamorphics have been compressed and show schistosity generally striking north to northeast and dipping east. Some of the principal veins follow this same strike and dip. There have been several subsequent minor movements, indicated by faults, shear zones and narrow veins and seams of quartz, striking in different directions. These in many cases faulted the earlier veins, as at the Hazel Mine. Many of the smaller pockety deposits are associated with intrusives such as diabase. In the Humbug district, some good ores were worked in serpentine, the principal mines having been the Boyle, Mountain Belle and Spencer. In general the work has been superficial. The best known mines in this entire region are the Morrison and Carlock, in Quartz Valley district, 4 miles northwest of Greenview, and the Hazel Mine southwest of Hornbrook. The former was being unwatered in the autumn of 1925, after many years idleness, and early renewal of work was planned at the Hazel.

Placer mining in this region has been on a small scale in later years, due to exhaustion of the more accessible ground and the protracted shortage of water. Developments in dredging are mentioned under that heading.

From Cottonwood Creek southward along Shasta Valley, and past Yreka, extend the ancient sedimentary deposits flanking on the east what was formerly the so-called 'Cretaceous Island,' previously mentioned. These beds consist of clay shales, sandstones, and shore gravels or conglomerates. The shale and sandstone contain beds of coal, and some of the beds are remarkably rich in shell remains and casts. This series in the region of the coal workings south of Ager, dips east 23° to 40°, the former figure being nearer the normal dip. These beds have been broken by a series of basaltic intrusions which show in knolls throughout the valley. The conglomerate was cut by the Klamath River and its nearby small tributaries in the region of Hornbrook and Cottonwood Creek, and was extensively eroded. This conglomerate was gold bearing and contributed probably most of the gold mined from the placers of Cottonwood, Rancheria, and other nearby creeks, and the immediate section of the river. Eastward of the conglomerate, the gravels of the Klamath River are said to be barren. A very interesting detailed account of this gold-bearing conglomerate written by R. L. Dunn, appeared in the Twelfth Report of the State Mineralogist, pages 459–471. The placers of the Cottonwood region, including Rancheria Creek, are estimated to have yielded about $4,000,000. According to figures of yield reported by Dunn in the above paper, from workings then being mined, the conglomerate in the Blue Gravel Mine yielded 60 cents per square foot of bedrock when hydraulicked, this being only a part of the gold content, due to loss in the unbroken masses of conglomerate passing over the dump. The portion next the bedrock, when worked in an arrastra, paid 88 cents per square foot of bedrock. The conglomerate is overlain by Cretaceous sediments. The easterly area of sandstone and shale has been classified as Tertiary. In recent years the Henry Bradley Mine near Hornbrook has been operated in the conglomerate. At present the coal south of Ager is being prospected by drilling. Several abortive attempts have been made to bring in oil wells in this vicinity and southward. Gas (probably dry marsh gas) was reported from a well 3½ miles south of Montague on the road to Grenada, and gas and alkaline water came from another shallow well. Six miles southeast of Montague, in the valley of Little Shasta River, some fresh water springs have been observed to emit gas.

All the north-central portion of the county, as described above, is accessible by roads from Yreka and other nearby points on the Pacific highway. Yreka, the county seat, is 286 miles north of Sacramento by paved highway. The entire region is served with electric power by California-Oregon Power Company. Timber is lacking in the Shasta Valley section, but is obtainable in the western part of the area. The elevation of this region ranges from 2000 feet to 5000 feet and there is some snowfall in all parts of it.

Klamath River District.

Until a few years ago the terrace deposits and bars along the Klamath River, and the placers along several of its tributaries, were the scene of the principal mining operations in the northwestern part of the county.

The country tributary to the Klamath on both sides remains for the most part difficult of access. The road following the river from the Pacific highway near Hornbrook to Martins Ferry, and climbing over the Bald Hills of Humboldt County, to a connection at Orick with the coast highway, has been completed only during the past two years. It is 76 miles from Hornbrook to Happy Camp over this road, and half of this is one-way road, the section of 30 miles from Hamburg Bar to Happy Camp being in such condition as to discourage travel. The maintenance of this road will be taken over by the State Highway Commission on January 1, 1926, and it is hoped some work will be done to improve it, at least by making numerous new turn-outs. For a distance of 120 miles from near Hornbrook to Somes Bar, this road follows the course of the Klamath River in this county and makes accessible one of the most extensive mining regions of the state. While the smaller and more easily worked placers along the river have been mined, there remain many terrace gravel deposits of interest to the hydraulic miner and numerous low bars offering possibilities for small scale drift mining operations. The gold quartz veins have not yet been prospected far enough to permit a fair opinion of their possibilities, but some very promising showings are being made. The area from the river northward to the Oregon state line and westward to Del Norte County, comprising many separate isolated districts, may be classed as the base metal district. At the west end, in the Preston Peak country, are numerous small copper prospects, now all idle. The Buzzard Hill Mine on the south and the Grey Eagle property north of Happy Camp mark a valuable copper mining district, sufficient work having been done to prove large orebodies in the latter mine. Quicksilver ores occur along the watersheds of Beaver Creek and Empire Creek, and copper and zinc ores have been noticed in the latter locality. From Indian Creek eastward to the railroad a number of gold quartz mines, mostly of pockety nature, have been opened. Prospecting and development of such properties is now going on along the upper courses of Indian, Thompson, Horse, Beaver and other creeks. On Independence Creek, 14 miles south of Happy Camp the Independence Mine has lately been making a fine showing of phenomenally rich gold specimen ore.

The Klamath River district as a whole is well supplied with standing timber and water for mining purposes. While the people of California have lately forbidden the building of dams in the Klamath River, the question of utilizing waters of the river for hydro-electric power generation is complicated by the matter of jurisdiction, most of this mining region being in the national forest, and to a certain extent under federal control.

Salmon River District.

This district has been the most productive, and remains the most active and important gold mining area of the county. It embraces the drainage of Salmon River, an area of about 800 square miles, including many formerly productive quartz mines and placer deposits, the latter exploited in later years almost entirely by the hydraulic process. Considerable quartz prospecting is going on, and there is also a revival of hydraulic mining, which for several years had been hampered by shortage of water. A good water season the past winter, with the hope of others to follow, and the successful operation of a few properties, have encouraged other operators to spend considerable money in equipping and rehabilitating their placer properties, and if there is a good water supply, the season of 1925–26 will be the most productive in many years.

The principal mining camps of the district are Sawyers Bar, on the North Fork of Salmon River 55 miles by road from the railroad at Gazelle, and the same distance from Yreka, the county seat; and Forks of Salmon, at the junction of the north and south forks of the river, 17 miles by road west of Sawyers Bar. Between Etna and Sawyers Bar, a distance of 25 miles, the road passes over the Salmon Mountains at an elevation of 5929 feet, and the heavy snowfall in normal years prevents travel by automobiles or wagons into the district during about four months of winter. A new wagon road along the Salmon River from Forks of Salmon connecting with the Klamath River road at Somes Bar, has been completed the present season, and gives this district an outlet to the coast system of highways via Orleans.

The more important placer mining operations are confined to the benches, back channels and bars of the North Fork of Salmon River between Sawyers Bar and Forks of Salmon, and to Eddys Gulch, a tributary of north fork entering it from the south at Sawyers Bar. There are also unworked placer deposits in Whites Gulch, a tributary of north fork entering it three miles east of Sawyers Bar; on the south fork in the vicinity of Cecilville and Forks of Salmon, on the main river down stream from the latter camp and some small areas on the tributaries near the main branches of the river.

Quartz mining in the past, and the prospecting and development operations at present, are confined mostly to two areas, one of black slaty schists and associated altered intrusives (closely similar to the Calaveras slates of the Mother Lode country), which extend across the heads of Eddys Gulch and Whites Gulch and southwestward past Black Bear, the other an area in the higher mountains on the headwaters of Russian Creek, where high grade ores are found in quartz veins and stringers along shear zones in black schists and muscovite schists. The geology of the deposits is more fully dealt with under the descriptions of individual properties.

There are only two or three small areas of a few acres each of arable land along the Salmon River, the balance of the district being an elevated mountain region, deeply dissected by the streams whose beds lie from 2000 to 4500 feet below the surrounding summits, so that the traveler is constantly climbing.

There is a good supply of timber for all mining purposes in this district. Water is available in the numerous creeks and gulches and in the Salmon River, in quantity ample for hydraulic and quartz mining, and in some places under conditions favoring hydro-electric power installations. The possession of these natural resources, and an exceptionally healthful climate, help to discount the remoteness of the district. The main North Fork of Salmon River has a grade of about 51 feet per mile from Sawyers Bar to Forks of Salmon, and the south fork 40 feet per mile. Electric power was brought in from Scott Valley to the Victory Mine during the past summer, and from the nearest point on this line, only a few miles of additional pole line would be needed to put power on all the mines at the heads of Whites and Eddys gulches.

The placers of the North Fork of Salmon River, in a distance of 17 miles between Sawyers Bar and Forks of Salmon have made an estimated production of $25,000,000 in gold. The sources of this were the numerous gold-bearing veins of the basin drained by Salmon River and its tributaries, most important of which were the last two named gulches, Russian Creek, and the south fork below the mouth of Black Bear Creek.

Elliott Creek District.

This district is on the north side of the Siskiyou mountains, the creek being a tributary of Applegate River. The principal property is the Blue Ledge Copper Mine, whose claims extend through the north central part of T. 47 N., R. 11 W., and the south central part of T. 48 N., R. 11 W. There are some other copper claims also in the district, and a few placer mines along Elliott Creek. This region is reached by road from Jacksonville, Oregon, 33 miles northeast.

Other Minerals.

Among the minerals found in this county, and mentioned in this report besides gold, are asbestos, californite, chromite, clay, coal, copper, lead, limestone and marble, platinum group metals, pumice, quicksilver, sandstone and miscellaneous stone. There are also numerous mineral springs.

ASBESTOS.

There are many large areas of serpentine, in which some prospects of asbestos occur and others may be expected, in this county. Most of these are too far from railroad for present consideration. Among the remote, unprospected areas may be mentioned the dikes and larger bodies of the rock which occur in the western part of the county, beginning six miles north of Orleans, thence recurring frequently along both sides of the Klamath River for many miles, and along the west side of the county to the Oregon line, as well as eastward along Salmon River from Somes Bar at intervals as far as Methodist Creek; near Hamburg Bar, north of Klamath River; near Scott Bar and in the Callahan district. Among the serpentine areas within reasonable distance of the railroad are the mountainous area adjacent to the county highway between Yreka and Fort Jones, and areas near Yreka, near Montague in Shasta Valley, and near Gazelle and Dunsmuir.

Burns Ranch. Owner, W. L. Burns, Gazelle. Patented land in Sec. 16, T. 42 N., R. 6 W., four miles west of Gazelle.

A little shallow work has been done on a chrysotile asbestos prospect, showing fiber up to 1¼ inches in length, but brittle. The quality might improve with depth.

C. C. Cady Asbestos Prospect on Greenhorn Mountain, between Yreka and Fort Jones, was leased in 1923 to Geo. Souza who did some work. The surface showing of asbestos here can be traced for a considerable distance.

Geo. W. Conrod, P. O. Box 577, Weed, sent in to the Bureau late in 1925, samples of slip-fiber (amphibole) asbestos. Locality not stated.

H. Johnson of Sisson has seven locations for asbestos on Eddy Mountain, southwest of Weed and near the Trinity County line.

J. J. Murray of Yreka several years ago located asbestos claims near the head of Seiad Creek, on a steep mountain four to five miles from the end of the wagon road, north of Seiad P. O. and nearly 70 miles from the railroad. Idle.

Shasta View Asbestos Prospect. Owner, W. S. Russell, Edgewood. In Sec. 8, T. 41 N., R. 5 W. Contains 12 unpatented claims, reached by three miles of good road from Edgewood. Elevation 4000 feet. There is plenty timber and water. Electric power is three miles distant.

Chrysotile asbestos occurs here and in 1921 a production of a small quantity of short fiber chrysotile was made. It was stated this carried 25% of fiber. Samples from the property show fully that percentage of fiber, one-half inch and less in length. There is some fiber one inch long.

National Cement Company of Modesto did some work in 1921–22 on the property, but it later reverted to Russell and is idle, except for assessment work. Development consists of short open cuts, not over 16 feet deep.

CHROMITE.

Considerable chromite was produced in this county during the war, and some of the remoter districts were just getting into production when the armistice was signed.

At the height of the war minerals 'boom' in 1918 the State Mining Bureau published a book of 248 pages, designated as Bulletin 76, "Manganese and Chromium in California," in which were listed and described practically all the then known deposits of these minerals in the state, and this book is still available at fifty cents a copy. As there has been no market worth mentioning for chromite from this state since 1918, except small lots of high grade ore from properties nearby the railroad, there appeared to be no occasion for new field work in this connection. The main facts regarding chromite properties in the county are given in synopsis following.

MINERAL PRODUCTION OF

Year	Gold, value	Silver, value	Chromite		Mineral water	
			Tons	Value	Gallons	Value
1880	$440,735	$95,340				
1881	850,000	1,500				
1882	720,000					
1883	400,000					
1884	475,000					
1885	338,659					
1886	342,677	64				
1887	606,859	177				
1888	625,000					
1889	915,294	370				
1890	860,303	23				
1891	957,220	120				
1892	1,013,332	56				
1893	799,108					
1894	760,782					
1895	950,006	177			200,000	$80,800
1896	1,091,265	653			[3]	
1897	842,123	34			[3]	
1898	768,804	321			[3]	
1899	991,771	100			[3]	
1900	951,397	[2]6,700			700,000	45,000
1901	886,043	[2]2,980			700,000	175,000
1902	906,989	233			750,000	187,500
1903	613,576	22			750,000	50,000
1904	892,685	1,230			750,000	50,000
1905	803,035	2,499			[3]	
1906	[3]	[3]			[3]	
1907	398,017	3,037			725,000	36,250
1908	504,156	6,125			700,000	80,000
1909	416,160	2,145			500,000	10,000
1910	437,376	2,322			500,000	60,000
1911	422,297	2,561			700,000	120,000
1912	472,314	2,980	220	$2,310	700,000	120,000
1913	[4]180,125	[4]1,228			700,000	120,000
1914	312,842	1,026			650,000	65,000
1915	426,716	2,081	[3]		626,680	62,990
1916	441,307	2,312	2,251	28,731	502,650	50,530
1917	325,550	16,883	2,046	49,797	503,000	50,600
1918	294,227	14,501	6,612	336,588	501,750	50,175
1919	226,525	17,049	510	13,379	451,500	90,375
1920	80,707	5,218	215	5,732	300,150	60,015
1921	42,635	294	[3]		250,150	5,015
1922	75,105	612				
1923	45,633	298			200,150	4,042
1924	63,570	296				6,100
Totals	$4,967.925	$193,567	[3]11,854	$436,537	[3]12,361,030	$1,579,392

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.
[2] Recalculated to 'commercial,' from 'coining value' as originally published.
[3] See under 'Unapportioned.'
[4] Production from dredging operations included in Stanislaus County production.
[5] Includes limestone and mineral water.
[6] Includes lead and lime.
[7] Includes coal, limestone, lime and platinum.

SISKIYOU COUNTY, 1880-1924.

Platinum Group Metals		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Ounces	Value		Amount	Value	Substance
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
100	$600	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	------	
------	------	------	------	$1,202,742	Unapportioned, 1900-1909
------	------	------	------	------	
------	------	------	200 lbs.	23	Copper.
------	------	------	------	------	
1.6	21	------	------	------	
5.3	93	------	2,500 cu. ft.	1,250	Sandstone.
------	------	------	2,500 cu. ft.	1,500	Sandstone.
------	------	$39,000	193 lbs. 2,643 lbs. 11,433 cu. ft. 1,000 bbls. 220 tons	39 140 12,897 1,000 300	Copper. Lead. Sandstone. Lime Limestone.
------	------	------	4,949 lbs. 1,800 cu. ft. 1,090 lbs.	1,183 1,485 1,680	Lead. Sandstone. Lime.
------	------	5,028	3,360 lbs. 50 tons 1,050 cu. ft. 100 bbls. 2,225 tons	144 500 1,750 300 2,200	Lead. Pumice. Sandstone. Lime. Limestone.
------	------	9,475	------ 1,204 cu.ft. 335 bbls. 35 tons ------	14,745 2,000 735 525 1,000	Gems. Sandstone. Lime. Limestone. Gems.
------	------	6,580	150 bbls. 24 tons 650 cu. ft.	120 24 455	Lime. Limestone. Sandstone.
------	------	609	250 cu. ft. ------	250 250	Sandstone. Gems.
------	------	4,883	------ 90 tons ------	250 2,000 1,500	Gems. Pumice. Other minerals.
9	304	5,371	100 tons 58 lbs. 677 bbls. 250 cu. ft.	500 2 629 150	Coal. Lead. Lime. Sandstone.
------	------	4,630	188 lbs. 745 bbls. ------	9 745 16,923	Lead. Lime. Chromite, copper, marble, sandstone.
[illegible]	------	45,407	------	12,609	Copper, building stone, lime, platinum, sandstone
15	709	134,382	------ 888,043 lbs. 192 lbs. ------	500 242,436 17 8,535	Granite. Copper. Lead. Lime, sandstone, soda.
1	58	24,588	573,593 lbs. ------	141,677 15,473	Copper. Lead and pumice.
7	1,015	26,405	------	111,294	Copper, limestone, pumice, quicksilver.
------	------	30,322	------	47,121	Copper, lime, limestone, potash, pumice,quicksilver
[illegible]	------	44,343	------	1,060	Asbestos, brick, chromite, lime, platinum.
------	------	21,726	------	4,020	Other minerals.[5]
3	339	129,291	------	1,408	Other minerals.[6]
------	------	67,787	------	3,034	Other minerals.[7]
[illegible]141.9	$3,139	$559,827	------	$1,861,129	

Attention should be called to the fact that since 1918 the Klamath River road has been made passable for trucks the entire distance from Hornbrook on the railroad to Somes Bar in the southwest corner of the county, where connection is made with the coast highways via Orleans. This opens up the large and only partly prospected areas of serpentine near the road, and is an outlet for the remoter areas west and northwest of the river to Del Norte County on the west and the Oregon state line on the north. This district was promising to be a big producer of chromite when the market failed, but the cost of hauling would be very heavy, as Happy Camp is 76 miles from Hornbrook.

The districts from which chromite production has been made in the county are: Callahan, Etna Mills, Fort Jones, Scott Bar, Yreka, Gazelle, Hamburg Bar, and Dunsmuir. In addition to these, and the others mentioned previously, there are other serpentine and peridotite areas (listed under Asbestos) not so far productive.

The production of individual properties was in few cases over 500 tons, the largest producer being the Coggins deposit, three miles south of west from Dunsmuir, where the ore contained 38% to 40% Cr_2O_3. The highest grade ore came from the Callahan district, where claims were 30 to 50 miles from Gazelle, the nearest shipping point. A large property near Hamburg Bar is about 48 miles from Hornbrook, and as it lies on the north side of Klamath River would require a bridge or tramway.

Besides the above localities, the following deposits have come to our attention since 1918, in addition to those listed in the tabulation of properties taken from our Bulletin 76:

H. Johnson of Sisson reports having a large tonnage of chromite six miles from the railroad, and within two miles of an old road.

Milne and Reichman Deposit. Owners, Geo. Milne and G. A. Reichman, Fort Jones. This is a large disseminated deposit of chromite 1¼ miles from the Scott Bar road, 44 miles west of Yreka. The chromite occurs in seams and high grade ore must be sorted. The average is low grade. Six hundred tons have been mined, and most of it hauled to Yreka. Idle since 1919.

Mountain Chrome Mine. Owners, W. D. and N. Dale, address W. D. Dale, 2668 Fourth Avenue, Sacramento. This is seven miles southwest of Edgewood, in Sec. 24, T. 41 N., R. 6 W., near North Fork of Shasta River. The owners state that 100 tons of ore have been mined and that they have crosscut the ledge for 80 feet without striking the other wall.

Peg Leg Mine. Owners, W. P. Johnson, N. Lambert and Mrs. F. A. Shebley. Address N. Lambert, Fort Jones. This is 14 miles southwest of Yreka via road to Fort Jones, and near Moffit Creek. High grade chromite, containing 50% Cr_2O_3 was mined in 1918 and 1919. Ninety tons was shipped, an equal amount was on hand and the prospects were good for opening a larger body in the lower tunnel when visited by a Bureau representative in July, 1919.

Other properties mentioned in Bulletin 76 are tabulated below:

Name of property	*Section, township and range*	*Length of haul, railroad shipping point*
Ball Ranch	16–41– 9	26 miles Yreka
Burns Ranch	16–42– 6	4 miles Gazelle
Butcher Ranch	--------	1 mile Yreka
Coggins	--------	3 miles Dunsmuir
Chastain	--------	--------------------
Cramer	22–44– 8	14 miles Yreka
Hamburg Bar	15–46–11 22–46–11 23–46–11	48 miles Hornbrook
Davis	10–39– 9	38 miles Gazelle
Dexter Ranch	--------	4 miles Montague
Facey	--------	--------------------
Flederman	10–41– 9	28 miles Yreka
Flederman Lease	__–43– 8	15 miles Yreka
Grant Lease	25–42– 9	14 miles Yreka
Grouse Creek	13–40– 8 19–40– 7	25 miles Gazelle
Le May	__–44– 7	--------------------
Martin-McKeen	34–40– 9	36 miles Gazelle
Masterson	14–40– 8	Gazelle
McCarthy	--------	32 and 42 miles Yreka
Musgrave	--------	--------------------
Souza Ranch	--------	1 mile Yreka
Sugar Creek	--------	40 miles Gazelle
The Chrome Mine	12–39– 9	36 miles Gazelle
Valine Ranch	--------	1½ miles Yreka
Wilson Ranch	--------	20 miles Yreka
Wurst	--------	35 miles Gazelle

At the time the chromite market collapsed, Siskiyou County was regarded as one of the largest prospective producers of the mineral in the United States, and it was estimated that the production in the next year would be 30,000 tons or more, mostly from the Klamath River deposits, located from Hamburg Bar westward.

COAL.

Lignite and sub-bituminous coal occur in Siskiyou County in Shasta Valley. Probably several thousand acres in this valley are underlain by coal.

Ager Coal Mine is on the Hagedorn Ranch, five miles south of Ager. Henry Hagedorn, owner. Years ago a slope 700 feet long on an incline of about 15° was sunk on the coal, which occurs between layers of hard shale, with alternating beds of hard sandstone above and below. The area has been mapped by Professor J. P. Smith[1] as Tertiary. The normal dip of the strata is about 23° east, but in this vicinity the sedimentary beds have been broken by a series of basaltic intrusions, indicated by a line of low hills running in a southeasterly direction. The dip of the beds increases to 40° NE. near this line. From the incline three drifts were run north a maximum distance of 500 feet, and three drifts south, the longest 400 feet, on the coal. A width of six feet carries coal, but the best, solid part of coal varies from 14 inches up to four feet, and is said to average two feet. The walls stood well without timbering. Five thousand tons or more have been produced and some of it sold. The last active work was in 1914–15 by Yreka Development Company, then lessee.

---

[1] Cal. State Min. Bur. Geologic Map of Cal., 1916.

Numerous prospect holes have been drilled in the same vicinity on the *Hagedorn, Herr, Cooley* and *Denny Ranches.*

On the *Cooley Ranch* a hole 130 feet deep is said to have struck 11 feet of coal at a depth of 118 feet. Another hole 106 feet deep is said to have struck 20 inches of coal at a depth of 95 feet.

Siskiyou Coal and Coke Company. R. D. Clark, President, Yreka. Leverett Davis, Mining Engineer. This company has leases on parts of ranches in Shasta Valley where coal has been found, as mentioned. In September, 1925, the company was putting down a diamond drill hole on the Herr Ranch, one-fourth mile north of the 106-foot hole mentioned above. The hole was down 110 feet and had not struck coal, which was not expected until a depth of over 200 feet. The core of the hole at time of visit showed alternating layers of sandstone and shale. The sandstone was most abundant, and some of it is quite hard. The coal dips NE. 40° according to C. B. Kay, the steeper dip being on account of the proximity to the line of basalt intrusives. The company reports tests on the coal where previously opened indicating coking possibilities, but a classification as bituminous coal.

In the southeastern part of the county, in townships 39 and 40 north, ranges 1 west and 1 east, there occur outcrops of sedimentary rocks, forming the northern part of an area of Triassic and Tertiary sediments which extend north and east from near Redding. Just south of the Siskiyou County line in Shasta County some coal prospects have been noted in this area in Tertiary formations, but are not known to extend into Siskiyou County.

There is a possibility of coal being found at the proper horizon anywhere in the Tertiary beds which are exposed from the Oregon line southward to five miles south of Ager, having a maximum width of eight or nine miles in townships 47 and 48 north, ranges 5 and 6 west, M. D. M. Such an occurrence is found on the James O. McMaster Ranch in the Hornbrook district, where nine feet of shale is intershot with small streaks and spots of soft coal, and there is also a seam up to two inches thick of what McMaster describes as "good hard coal, making a hot fire with a blue-green gaseous flame."

COPPER.

Very little progress has been made in the county in copper mining the past four years. After the price of copper fell, following the war, there was little incentive for the copper miners of Siskiyou County to produce ore, and since 1920 practically only necessary assessment work has been done. No new field work was done, therefore, among the copper mines and prospects for this report, and the following notes are a compilation of past reports, scattered among various publications in the past, but gathered here for readier reference; also a list of newer prospects.

Siskiyou County apparently contains some of the best unworked copper deposits in the state. The two most promising districts are near Happy Camp in the western part of the county, and near the northern county line on the headwaters of Applegate River. The two principal proved properties are the Grey Eagle near Happy Camp, and the Blue Ledge in the Elliott Creek district. There are numerous copper prospects throughout both the western and northern parts of the county, where gossan outcrops occur and have been slightly prospected, but not sufficiently to definitely indicate their possibilities. So far as known, only assessment work was being done in 1926.

The greatest hindrance to development of this branch of mining is the remoteness of the region from railroads. Happy Camp is 76 miles from railroad and most of the copper prospects are still farther away. From time to time there is talk of a railroad being built from the vicinity of Hornbrook down the Klamath River, and the possibility of this being done was last discussed in the summer of 1925, when John C. Sexton brought the subject of right of way before the county supervisors and according to press dispatches, stated a large tonnage of copper concentrate has been promised if the railroad were built. Due to the districts being in the national forest the federal government would not permit operation of a smelter.

Bulletin 50 of the California State Mining Bureau lists 45 prospects of copper in this county. This bulletin was published in 1908. Since that time, the Blue Ledge and Grey Eagle properties have been extensively developed and proved to contain considerable ore. Little has been done with the others. The principal production of copper occurred in 1917 and 1918, when about 1,460,000 pounds were sold. Developments in the past few years have served to emphasize the widespread distribution of copper prospects.

Ames Prospect. Owner, A. Ames, Happy Camp. One claim on a gossan outcrop on the southwest slope of Clear Creek Canyon, eight miles by road and three miles by trail from Happy Camp. Only assessment work is being done.

Barton Claims. Owner, H. J. Barton, Yreka. Claims on Horse Creek, nine miles upstream from the mouth. Formerly known as the Hetchell prospect. Contains four claims. Idle.

Barnum Brothers Copper Prospect. (*Copper Mountain Group.*) Owners, Barnum Bros. et al. This group comprises 19 claims on Sambo Creek in Oak Bar district. It was equipped with a compressor and air drills in 1919 and in 1925 was under lease to Williams of Yreka, who was continuing an adit. Several hundred feet of underground work has been done.

Blue Ledge Mine. Owner, Mexican Smelting & Refining Co., 82 Beaver St., New York City. (Reported sold to Guggenheim interests in 1924, but is still assessed to above owner.) This property comprises 26 patented claims in T. 47 and 48 N., R. 11 W., in Elliott Creek district, at an elevation of about 5000 feet. Jacksonville, Oregon, is the nearest town and is 33 miles northeast.

The footwall of deposit is grey to black micaceous schist and the hanging wall is a white mica schist. The vein strikes nearly north, dips 60° west and averages 5 feet wide, though reaching a maximum width of 35 feet. A pay shoot 1500 feet long and 5 feet wide is reported proven by a series of adits and drifts which have developed the vein for a length of 1800 feet and a depth of 600 feet. In 1920 the management estimated that there were 240,000 tons of ore blocked out, having an average content of 4.8% copper, .035 oz. gold and 1.5 oz. silver. It is essentially chalcopyrite, and pyrite, the iron content going as high as 32%. The mine was operated up to the latter part of 1920 but has been idle since. Nearly 9000 tons of sorted ore was shipped. It contained an average of 13.7% copper, 5.5 oz. silver, .1 oz. gold, 30% iron and 30% sulphur. Steam was used for power, wood fuel from the claims being utilized. There is a compressor, air drills and underground hoist.

Bibl: Cal. State Min. Bur. Bull. 50, p. 123. R. XIV, p. 817; XVII, p. 530.

Buzzard Mine. See under gold quartz mines. The ore exposed in the mine workings immediately under the oxidized ore is a heavy sulphide, mostly pyrite, with a small amount of copper.

Clear Creek Mine. (*Davis Mine.*) Owners, Estate of Reeves Davis, et al. It is on Clear Creek, 13 miles southwest of Happy Camp. It has been quite extensively prospected, and gave an encouraging showing, but it is said that a good sized orebody could not be found in place. Idle.

Dillon Creek Prospects. In the summer of 1917, following a forest fire which cleared off the brush, eleven copper claims were located in the vicinity of the headwaters of Dillon Creek, which enters the Klamath from the northwest near Cottage Grove. Later the Grey Eagle Copper Co. did some prospecting in this vicinity, but the result of this is not known. The original locators of the claims were: Jettie Albars, Jack Davis, Swaney Peters, Wm. Elliott, Chas. and M. Thomas; Henry, Mrs. J. C. and Mrs. J. Aubrey, all residents of the Blue Nose and Somes Bar districts.

Efman & Boorse Prospect. Owners, Mike Efman and H. G. Boorse, Happy Camp. This is an undeveloped claim on a gossan outcrop in Elk Creek Canyon, two miles south of Happy Camp. Only assessment work was being done in 1925.

Grey Eagle Mine. Owner, Mason Valley Mines Co. of Nevada. It comprises 32 claims, mostly patented, in Sec. 4 et al., T. 17 N., R. 6 E., H. M., on mountain on the east side of Indian Creek, north of Happy Camp and 80 miles by road west of Hornbrook, the nearest railroad station. The elevation of main adit, No. 7, is 2539 feet.

The deposit is an ore zone trending southeast, varying in width from 10 to 80 feet, and carrying ore along fracture planes normal to the grey schist country rock. The ore is principally chalcopyrite, carrying an average of 6% copper. The sulphide ore is covered by a gossan cap. No. 7 adit has been run about 3000 feet southeasterly and

SAN DIEGO COUNTY MINERAL PRODUCTION, 1880-1924.

Year	Gold value	Silver value	Brick M	Brick Value	Gems value	Granite value	Mineral water Gallons	Mineral water Value	Salt Tons	Salt Value	Miscellaneous stone value	Miscellaneous and unapportioned Amount	Miscellaneous and unapportioned Value	Miscellaneous and unapportioned Substance
1880	$91,558													
1881	60,000													
1882	100,000													
1883	50,000	$5,000												
1884	65,000	5,000												
1885	15,125	2,000												
1886	110,450	78,758												
1887	62,000	158,537												
1888	160,000	152,000												
1889	225,400	25,740												
1890	451,800	100												
1891	467,000													
1892	550,518	2,051												
1893	105,800													
1894	266,100	150							700	$5,000	$19,274	50 tons	$2,250	Selenite
1895	411,008	600					18,000	$11,500	700	5,000	25,000			
1896	541,578	40					15,000	35,000	600	4,800	3,573			
1897	[illegible]						25,000	3,000	650	5,850	23,350			
1898	671,196	500	672	$2,688		$1,875	8,320	3,000	400	5,000	5,350	3,100 lbs	1,317	Lead
1899	331,650		800	4,300		8,150	12,000	6,000	400	5,000	16,158	125 tons	4,600	Lithia mica
1900	255,707	1,500	711	3,250	$5,000	9,500	8,500	4,250	600	6,000	11,403	440 tons	11,000	Lithia mica
1901	413,320	2,800	1,156	5,791	20,000	22,000	6,000	5,000	1,000	9,020	6,857	1,100 tons	27,500	Lithia mica
1902	439,822	1,151	688	3,440	150,000	15,175	3,155	1,250	7,000	7,000	14,173	822 tons	31,880	Lithia mica
1903	161,510	1,166	2,150	11,150	100,000	16,326	6,000	3,000			12,537	700 tons	27,300	Lithia mica
1904	314,457	100	3,821	23,200	170,000	7,851					200,192	641 tons 4,005 lbs	25,000 760	Lithia mica Copper
1905	107,712	100	1,100	28,450	50,000	10,250					16,507	25 tons	276	Lithia mica
1906			1,950	31,900	284,500	10,250			6,000	5,000	19,738	13,246 lbs	2,059	Copper
1907	7,455	35	1,474	36,420	206,316	21,450	2,000	2,000	7,000	35,000	28,500	171 lbs 4,009 cu ft	32 12,000	Lead Marble
1908	6,520	46	2,112	16,719	121,200	$10,000	9,810	11,772	7,000	49,000	37,122		216,034	Unapportioned 1908-1909
1909	12,812	4,721	5,810	35,140	125,000		10,210	12,022	18,000	68,000	33,510			
1910			8,813	62,617	110,500		10,550	30,110	8,000	24,000	117,817			
1911			9,500	66,000	25,000		60,000	87,020	13,000	37,500	201,485			
1912			10,500	80,000	12,500		52,000	17,218	12,150	31,350	164,115	400 tons	500	Pottery clay
1913			9,351	68,300	7,465		51,500	15,225	20,500	51,750	170,014	835 tons	2,840	Pottery clay
1914			3,457	56,302	4,150		8,865	911	15,300	16,200	210,250	10 lbs	1 1,365	Copper Other minerals
1915	1,361	9	1,260	21,025	2,165		10,350	1,035	17,610	19,016	163,723	2,008 lbs 23 lbs 2,150 tons	550 1 175,800	Copper Lead Potash
1916			4,100	36,812	2,700						163,025	10,800 lbs	1,144 13,110	Copper Granite, lithia, mineral water, salt
1917			and tile	21,121					4,500	9,250	125,855	283 tons 161,510 lbs 5,252 tons	613 43,502 1,492,121 21,035	Pottery clay Copper Potash Pottery clay, gems, granite, lithia, mineral water, molybdenum, silica, silver
1918				21,060					10,611	91,717	184,158	1,143 lbs 700 tons 10,472 tons	1,023 3,600 1,578,474 83,698	Copper Feldspar Potash Granite, lithia, mineral water
1919	1,470	12				15,215			12,400	52,800	141,[illegible]		62,929 64,700	Clay and clay products Copper, gems, lithia, mineral water, potash, silica
1920				87,612	2,100	7,838			15,300	77,100	333,817	5,552 tons 2,963 tons 7,557 tons	57,522 17,715 18,857 101,442	Pottery clay Feldspar Silica, glass sand Lithia, magnesium salts, mineral water, tantalum ore, tourmaline
1921					5,105	22,444	70,521	9,161			157,722	 170 tons 1,830 tons	92,000 725 11,106 176,016	Clay and clay products Glass sand Feldspar Gold, lithia, magnesium salts, marble, salt, silver
1922					400	15,673	71,781	262			355,810	1,500 tons	21,503 93,045 153,117	Feldspar Clay and clay products Fuller's earth, gold, lithia, magnesium salts, marble, salt, silica, silver
1923	837	144			8,530	10,600	51,765	6,470			113,55[illegible]	5,000 tons 6,100 tons	100,977 42,500 277,394	Pottery clay Feldspar Brick and tile, Fuller's earth, lead, magnesium chloride, marble, salt, silica, quartz
1924	1,850	57		232,113	1,225	21,000	107,102	8,642			379,044	12,783 tons 6,550 tons 10½ tons	36,941 47,950 2,260 205,252	Pottery clay Feldspar Lithia Arsenic, Fuller's earth, magnesium chloride, salt
Totals	$37,317,552	$528,355	78,571	$973,209	$1,333,756	$102,585	702,010	$261,637	178,107	$613,953	$3,842,108		$3,451,177	

¹Includes crushed rock, rubble, rip-rap, sand, gravel, paving blocks, grinding-mill pebbles.
²Distributed to "commercial," from "granite" value, as originally published.

³See under "Unapportioned."
⁴Included under Imperial County production.

a total of about 10,000 feet of underground work is reported from this adit. Ore exposed on this level is said to be mostly pyrite, but where raises have been put up good ore has been exposed, as was also the case in the upper adits. Over 1,000,000 tons of ore are claimed to have been blocked out. The mine is equipped with a steam plant, large compressor, electric light plant, shops and buildings. Water is taken from nearby branches of Indian Creek. There were 60 men employed between 1916 and 1918, since when the mine has been idle.

Bibl: Cal. State Min. Bur. Bull. 50, p. 132. R. XIV, p. 818; XVII, pp. 531–532.

Henry Wood, Seiad P. O., has a copper prospect on Beat and Bender Gulch, near the Portuguese Mine, and has been doing some work the past summer.

Isabella Copper Mine. Owner, Isabella Copper Mining Co., 3228 Adeline St., Berkeley, Cal. This is a prospect containing 120 acres, in Sec. 34, T. 41 N., R. 7 W., 18 miles southwest of Gazelle. The vein is said to carry 'grey copper,' silver and gold. It has been developed by a shallow shaft and several adits. Equipment includes a steam plant, small air compressor and air drill.

Bibl: Cal. State Min. Bur. R. XVII, p. 532.

Liberty Bond Group. Owner, F. B. McCann, Happy Camp. This comprises 11 claims on a ledge in schist near a limestone contact. The ore is said to carry 1 to 1½% copper and several dollars gold per ton. Only assessment work has been done.

Bibl: Cal. State Min. Bur. P. R. 8, p. 14.

Malone Mine. Owners, Churchill, Roseburg et al. of Yreka. It is in Elk Creek Canyon, 14 miles by trail south of Happy Camp. Some good looking sulphide ore, carrying pyrite and chalcopyrite, has been exhibited from this property. The principal work is an adit 160 feet long.

Parker Group. Owner, Geo. J. Parker, Copper P. O. This comprises six unpatented claims in Sec. 20 or 21, T. 48 N., R. 11 W., in Elliott Creek district. About 200 feet of prospect adits have been run. The owner has been working alone.

Sunshine Group. Owner, W. J. Brown, Happy Camp. It contains two unpatented claims on a copper-bearing outcrop on Cave Mountain, five miles northeast of Happy Camp, three and one-half miles being by trail up the canyon of the creek. An adit has been run 130 feet at an elevation of 2040 feet, and it is expected the vein will be cut by raising 15 feet. Only assessment work is carried on.

DIATOMACEOUS EARTH.

Ed Ewing, Yreka, has written the Bureau that he has 520 acres of land on which diatomaceous earth outcrops. This deposit has not been visited by a Bureau representative, so no particulars are available as to its location or quality.

GOLD.

Gold Mines (Lode).

Advance Mine. Owner, Victory Gold Mines Company. A. M. Buley, president. Office 1104 Pacific Mutual Building, Los Angeles. John Nefroney, manager. Comprises four patented claims, 73½ acres, in NW¼ Sec. 16, T. 40 N., R. 10 W., 23 miles by road and trail from Etna Mills at an elevation of 5000 feet.

This mine was discovered in 1902 and according to records kept by Woods, the former owner, has produced over $250,000 most of which was taken out in 1906 and 1907, and principally in the form of 'high grade' or specimen ore. A five-stamp mill was operated on North Russian Creek and ore was hauled and trammed to it. The mine was sold to Victory Gold Mines Company in 1923 by Henry E. Woods.

Some of the old workings on the Advance show a quartz vein from two feet to four feet wide, which strikes N. 10° E. and dips to the west from 60° to nearly vertically. This vein carries calcite and in places shows free gold. These workings were 100 feet or less in depth, and some of the old crosscuts, drifts and stopes were open at intervals for several hundred feet along the north slope of the mountain. The recent work done by the company is on the south end of the Advance, and extending into the Hardscrabble claims. A boarding house, shop and portable gasoline driven air compressor have been placed here and drifting southward was in progress at time of visit, October 29, 1925.

The geological formations opened by work on this and adjoining claims comprise a series of belts of black schist, with schistosity striking north to N. 20° E. and dipping steeply west. This schist is everywhere penetrated by dikes, which strike usually parallel to the schistosity. They range from light to dark in color and in character from 'birdseye porphyry' and finer grained diorite to white rhyolite. The schist belts are at times 50 feet or more wide. In the schist, and running parallel to its schistosity, occur numerous stringers and small veins of quartz, some of which carry free gold. In the three adits started here, which were each 50 feet or less in length at time of visit, the schist belt is shown to carry a great deal of quartz throughout its width, the stronger veins having a width of nearly a foot, and lying on the footwall side of a 'birdseye' porphyry dike, near the footwall of the schist. Sacked ore shows free gold, and some samples of quartz broken from the formation in place panned well in gold. No proper system of sampling, assaying or mill tests has yet been adopted to determine the average value of this entire width of schist. The southernmost workings were stated to have crossed the south line of Advance property into the Hardscrabble.

The Mountain Lion vein lies 200 feet east of the Advance vein, strikes N. 10° to 20° E. and dips west nearly vertically. It is from two to five feet wide. The outcrop has been stripped for a short distance, showing a white dike on the immediate hanging wall.

Electric power could be brought from the Victory power line, a distance of three miles or less. Ten men were employed late in October, but it was expected the crew would be transferred to the Victory workings as soon as winter began.

Ames Prospect. Owner, A. Ames, Happy Camp. One claim adjoining Independence Mine, 14 miles by road south of Happy Camp. The owner has done only assessment work, and reports a prospect of 30 inches in width of quartz, panning well in gold, and believes the vein very similar to that in the Independence.

Bailey Mine. In Sec. 35, T. 46 N., R. 9 W., seven miles NW. of Fort Jones, at an elevation of 5000 feet. Pocket mine. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 826.

Baker Mine. In Sec. 15, T. 44 N., R. 9 W., 7½ miles north of Fort Jones, at an elevation of 5000 feet. Pocket mine. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 826.

Baldwin Group. Owner, J. C. King, Callahan. Contains 100 acres in W½ of Sec. 18, T. 40 N., R. 7 W. in Callahan district, at an elevation of 3300 feet and 23 miles from Gazelle.

According to a field report by C. McK. Laizure[1] an iron capped deposit containing quartz seams along a serpentine contact had been prospected by a shaft 60 feet deep, and the limonite and hematite showed some gold on panning.

Ball Mine. (See *Ida May* and *California Consolidated.*)

Ball & Goforth Prospect is in the Cecilville district. About 30 tons of ore were reported ready to mill in a small ball mill late in 1925.

Barnum Brothers Quartz Mine (formerly *Robertson Mine*). Owners, Al, Ira and Wiley Barnum, Oak Bar. On Horse Creek 6½ miles by road from Klamath River and 43 miles west of Hornbrook. A four-foot vein and rich stringer are being prospected. A Straub mill has been installed and in September, 1925, the owners were extending the road one-half mile up the creek from the Cook Placer Mine to their property.

Bender Mine. Forty acres in Sec. 18, T. 42 N., R. 11 W., four miles north of Etna Mills, at an elevation of 3300 feet. A short ore shoot in limestone and diorite is said to have yielded some specimen ore years ago, when it was worked through a 340-foot tunnel, with 250 feet of drifts on the vein.

Bibl: Cal. State Min. Bur. R. XIV, p. 826.

Big Ledge is six miles northeast of Greenview in the Oro Fino district and was formerly worked through an adit 360 feet long, producing some pockets.

Bibl: Cal. State Min. Bur. R. XIV, p. 826.

Black Bear Quartz Mine. Comprises 70 acres, patented, seven miles by road southwest of Sawyers Bar at an elevation of 4200 feet, near the west line of T. 39 N., R. 11 W. Owned by heirs of John Daggett, Black Bear P. O. This has been the most productive quartz mine in the county, with a past production of about $3,100,000, but practically nothing has been done with it during the past 12 years. Original records of the operations under Daggett between 1870 and 1880 indicate a monthly bullion output of as high as $75,000 with 16 light stamps.

---

[1] Mining Engineer, State Mining Bureau, formerly in charge of Redding office.

The mine was discovered in 1860, and for a year the ore was worked in an arrastra. In 1862 a 12-stamp mill was built and operations continued until 1865. The ore occurred in lenses, and it has been the history of the property that whenever one of these orebodies was worked out the operators became discouraged. At the above time, the property was sold to John Daggett, then Lieutenant Governor of California, and associates. They found another orebody and between 1866 and 1872, produced $405,691 of which $225,802 was paid in dividends. While still in ore, they sold to an English company, which between 1872 and 1886 produced $1,933,745, and paid $616,500 dividends. Ore becoming exhausted again, the owners sold out to Daggett, who resumed work and opened up the Yellow Jacket ground. Daggett from that time until his death only a few years ago retained ownership, except for a short period of operation by Rollin Mining Company.

The mine was worked through six adits and two shafts, one of the latter reaching a depth of 600 feet below the outcrop, where, it is said, there was a showing justifying work. On account of inadequate equipment and lack of funds the later operators, including F. A. Gowing, who had a lease on the mine in 1922, were unable to clear these old workings and get into deeper ground.

The vein occurs in 'slate' striking north and dipping east 25° to 40°. At this late date, due to the death of Daggett and the absence of others acquainted with workings now inaccessible, it is impossible to give an idea of underground geologic conditions, but is believed that the property is similar geologically to the Klamath, Mountain Laurel and others on the same belt, except that the Black Bear ground has been less disturbed and broken. 'Porphyry' forms the footwall in places, and the ground is heavy.

The equipment is antiquated, although much of it could be utilized. Water is obtainable from Black Bear and Auges creeks through flumes each one mile long, and 1600 feet of pipe line. Electric power from a 100-h.p. plant two miles distant was used for the last operations. There is a compressor, tools and other equipment in great variety, and an old mill of 16 stamps weighing 650 pounds each. There are also a number of buildings. Eight stamps have been moved to the mine.

Bibl: Cal. State Min. Bur. R. VIII, pp. 620, 621; X, p. 656; XI, p. 431; XII, p. 277; XIII, p. 389; XIV, p. 826.

Black Hawk, Hidden Treasure and Triangle. Owners, W. L. McClaughry and Fred Martin, Yreka. Claims in Humbug district 16 miles west of Yreka at an elevation of 4400 feet. Two veins averaging about six inches wide have been prospected by adits 168 and 100 feet long. Said to have 500 tons of ore on hand at time of last report.

Black Hawk is in Sec. 31, T. 46 N., R. 7 W., five miles north of Gottville. Formerly a small pocket producer.

Bibl: Cal. State Min. Bur. R. XIV, p. 827.

Blind Lode Mine. Owner, Estate of H. J. Diggles. A patented claim, 17 acres, Lot 53 in Sec. 12, T. 43 N., R. 10 W., in the Oro Fino district. Was worked in early days and said to have produced $40,000 from a six-inch vein in diabase.

Bibl: Cal. State Min. Bur. R. XIV, p. 827.

Blue Jay comprises 160 acres, patented, in Sec. 11, T. 47 N., R. 8 W., five and one-half miles north of Gottville. Operated 20 years ago by Blue Jay Mining Company. There were two adits, 250 and 400 feet long, on a low grade vein up to five feet wide. There is an old 10-stamp mill.

Bibl: Cal. State Min. Bur. R. XIV, p. 827.

Bonanza Group. Owners, J. F. Wyrick and L. R. Pownell, Forks of Salmon. Three unpatented claims 2½ miles by road east of Forks of Salmon, the last mile being steep sled road. The claims are on the ridge between Crapo Creek and North Fork of Salmon River at an elevation of 3750 feet.

The owners report a vein averaging four feet in width striking east and dipping north. It was discovered in 1908 and has been developed by 19 tunnels and open cuts, from 25 feet to nearly 300 feet long. The ore is of good grade. The property has been worked exclusively by the owners for a number of years. Ore is crushed in a Gibson mill. Ore is delivered from the mine to mill by an aerial tram 1200 feet long.

Bonanza. In Sec. 14, T. 46 N., R. 7 W., 10 miles southwest of Hornbrook in the Cottonwood district. The locator produced $10,000 from a pocket. Later a tunnel 1600 feet long was run. Formations are hornblende schist and diorite.

Bibl: Cal. State Min. Bur. R. XIV, p. 828.

Boss Mine. Owners, W. H. Wescott, Rollin P. O., et al. One claim on west side of Eddys Gulch in Sec. 16, T. 39 N., R. 11 W., three-fourths mile south of Rollin P. O. at an elevation of 3900 feet. This claim has been worked since 1888. It formerly belonged to the Dunphy Estate.

A vein from a few inches to two feet wide strikes N. 62° E. to N. 80° E. and dips 80° north, between a black slaty schist footwall and a hanging wall of similar rock, in which appear bunches and areas of decomposed acid dike rock locally called 'cab,' forming at times the immediate hanging wall. Several oblique faults of small throw have been encountered. The vein is usually tight, with hard walls and little or no gouge.

The lowest working is a crosscut 250 feet long, to the south, from which an inclined raise 97 feet long connects with a crosscut of 50 feet and a drift of 140 feet on the vein and fissure, which in places narrows, but is well marked even where devoid of quartz. This is new work, from which no ore has been milled. It is about 200 feet below the outcrop. Two old higher adit levels followed the vein for 100 feet and 140 feet, respectively, and in the upper of these workings a stope 100 feet long was worked on ore one foot wide, and said to have paid well.

Five men were employed late in 1925 laying track and preparing for erection of a small mill, as the owners believe this is justified by development in the lowest drift. Water sufficient for milling for six to eight months annually can be had from Evening Star Gulch, a small tributary of Eddys Gulch.

Boulder. Owner, J. M. Campbell, Dunsmuir. A prospect in Sec. 30, T. 29 N., R. 3 W., in the Soda Creek district. A vein said to average six feet in width has been prospected by the owner who has driven a main adit 350 feet long and several crosscuts, the total amount of work being nearly 2000 feet. The vein is free milling.

Boyle. In Sec. 8, T. 45 N., R. 8 W., 14 miles west of Yreka in Humbug district. Formerly operated through five adits, the longest 900 feet long, on two parallel veins striking northwest.

Bibl: Cal. State Min. Bur. R. XIV, p. 828.

Brown Bear. (See *Cleaver Mine.*)

Burton. R. H. Burton, Fort Jones. Claim and two 1000 pound stamps in Sec. 1, T. 44 N., R. 6 W. Idle most of the time in recent years.

Buzzard Hill Mine. Owners, Samuel J. Dunaway, Alvin Smith and Tony Kenney et al. Lessee with option to purchase, Buzzard Hill Mines, Inc. H. C. Cutting, president and general manager, Happy Camp, and 859 Monadnock Building, San Francisco. Comprises 12 unpatented claims, 7½ miles by road south of Happy Camp on Buzzard Creek, one mile south of Klamath River by private road, in Secs. 4 and 5, T. 15 N., R. 7 E. Elevation 1500 feet. The nearest railroad point is Hornbrook, 80 miles east.

The deposit is a vein of heavy pyrite ore, striking N. 14° E. and dipping 25° to 37° E. The width of vein varies from 2 feet to 12 feet as sampled, averaging over four feet. The ore has been almost completely oxidized to the outer part of No. 1 adit, about 90 feet on dip of vein, and above this working forms a soft, porous, light and easily workable mass, carrying finely divided free gold and quartz. The wall rock is dioritic or other basic schist.

No. 1 or lower adit runs north and east over 250 feet, showing heavy pyrite for most of this distance. The gossan ore shows little sign of copper to the unaided eye, but samples of massive sulphide taken in the east crosscut from No. 1 adit and tested in the State Mining Bureau's laboratory showed one per cent to two per cent copper, and this ore shows some chalcopyrite and a little malachite.

No. 2 adit, 54 feet on the dip above No. 1, cuts the vein 50 feet from the portal and is on oxidized ore for a distance stated to be 180 feet. At this point it is easy to observe that the work was turned east to follow a spur a short distance. There are two short intermediate levels between No. 1 and No. 2, and three raises from No. 1 to No. 2. The vicinity of the faces of different levels shows partly oxidized and partly sulphide ore, the level of sulphide ore rising as distance and elevation from the creek increases. The claims are only slightly prospected by the work done and if the sampling and assaying of the oxide orebody is truly representative, it should prove a profitable ore to work. According to estimates by M. J. Conover, there are 7900 tons of oxide ore available and proved, of an average value high enough to pay a good profit. So far the company has done little toward milling the ore, and has not definitely decided upon the system to be used.

From the Buzzard workings to the Outlook workings, a distance of 2600 feet on the strike, no work has been done, but the vein has been slightly prospected at the Outlook. The work at the Buzzard group has been almost entirely for the purpose of prospecting the oxide ore. Such assays as are available for the sulphide ore show it to be low grade in gold, silver and copper.

The camp buildings include new mess and bunkhouse, superintendent's house, assay office, garage, and machine shop and blacksmith shop. A small Hardinge mill, a rock breaker and Vandercook mercuric cyanide equipment have been delivered, but installation was suspended pending further tests of the amenability of the ore to this treatment. Power has not yet been provided, and can only be supplied economically by generating electricity locally. Buzzard Creek flows through the property, but is not large enough to furnish much power in the dry season. Some other creek, such as Elk Creek or Clear Creek, both within three miles, might be utilized. Properly constructed current wheels in the Klamath River could be used for generating power except at the height of the rainy season, when the river rises so suddenly and flows so swiftly that only the most rugged structures can stand against it. There is an ample stand of timber on the claims and near by on the national forest, and the company has a small saw mill.

Cape Cod comprises 40 acres, patented, and 75 acres unpatented, in Secs. 18 and 19, T. 45 N., R. 7 W., six miles west of Yreka. Reported production $12,000 from 300 foot adit on two narrow parallel veins.

Bibl: Cal. State Min. Bur. R. XIV, p. 829.

Cassadoga Mine. Owner, J. L. Corbett, Hilt. Covers 3000 feet on strike of vein in Sec. 2, T. 47 N., R. 8 W., ten miles by road and trail west of Hilt on Bullion Mountain at an elevation of 5500 feet. According to a report by the owner, a vein striking east and averaging three feet wide lies between a granite footwall and mica schist and porphyry hanging wall. A tunnel cut the vein at a depth of 125 feet and it has been drifted on for 450 feet, with five raises of 50 feet each. Corbett claimed an ore reserve of 8000 tons of good grade in 1920, at which time the property was equipped with a 2-stamp steam mill, and was idle. Lately work has been resumed and during the past summer a 10-stamp mill was reported in course of erection.

Bibl: Cal. State Min. Bur. R. XVII, p. 533.

Central Mine. (See *Union Mine.*)

Central. An old property in Sec. 34, T. 48 N., R. 8 W., 16 miles northwest of Hornbrook in Hungry Creek district.

Bibl: Cal. State Min. Bur. R. XIV, p. 829.

Champion Mine. Owners, W. F. and J. A. Hunter, Orleans. Nine quartz claims in Sec. 33, T. 12 N., R. 6 E., H. M; eleven miles by trail from Orleans and 60 miles from Korbel, the nearest railroad point.

The owners worked the claims from the time of discovery in 1909 until 1917. Development consisted of two adit levels, which were 100 feet and 335 feet long at time of last report. The owners did all the work by hand. There is one 1000-lb. stamp and a two-ton cyanide plant. Water from Ten Eyck Creek is used for power. The vein is reported three feet or more wide, and bunchy, and owners claim considerable ore proven.

Bibl: Cal. State Min. Bur. R. XIV, p. 829; XVII, p. 533.

Chapman Prospect. Owners, J. and H. H. Chapman and T. L. Petersen. In Sec. 30, T. 7 N., R. 40 N., on Scott Mountain seven miles from Callahan and one-half mile from the Callahan-Carrville road. In 1922 a 5-stamp mill was built at the foot of the mountain four miles or more from the prospect and ore was hauled out through the snow in the spring at a great expense. About 40 tons milled are said to have yielded $856. This came from a narrow seam in a shaft 80 feet deep, with a few feet of drift, where pay was lost. Previous work in an adit had produced about an equal amount. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 180.

Cherry Hill Mine. Owner, P. D. Thompson, Yreka. Comprises nine claims in Sec. 25, T. 45 N., R. 8 W., eight miles southwest of Yreka. This property has been worked for a long time in a small way. In later years the owner has been doing well working the property, and claims the ore will run about an ounce of gold per ton. On Cherry Hill, numerous veins and seams occur, some striking N. 60° to 70° E., and dipping 60° SW. Others strike N. 25° E. and dip 40° to 50° SE. These have been worked by a series of tunnels.

The claims are equipped with a small 4-stamp mill operated by a gas engine.

Cleaver Mine (formerly *Brown Bear* or *Golden and Eveleth*). Owner, I. K. Cleaver, Sawyers Bar. Contains seven unpatented quartz locations, of which the Eveleth, Brown Bear and Crystal have been most productive. In Sec. 14, T. 39 N., R. 11 W., on ridge at the head of west fork of Whites Gulch, elevation 4600 feet to 5090 feet. Sawyers Bar, the nearest town, is seven miles northwest and the mine is reached only by four miles of trail, leaving the road at the mouth of Whites Gulch.

The mine was first worked 35 years ago by Golden and Eveleth, who owned the claims several years and did most of the development. The Eveleth and Brown Bear claims are credited with a production of $40,000 in all, and the Crystal, a fractional claim 300 feet long, with a production of $35,000. A 4-stamp, water-power mill was operated about three months annually at that time, but at present is dismantled though still on the property. Most of the workings are now inaccessible because of caved ground. The lowest adit on Brown Bear claim, elevation 4640 feet (aneroid) was open for 200 feet at time of visit. This is 300 feet vertically below the summit of the ridge.

The principal vein strikes due east and dips 38° north. In the accessible portion of the lowest adit, the vein occupies the entire width, at least, of the adit, and a crosscut at the 200-foot point shows a width of 19 feet of solid quartz, stained by iron. In places it encloses brecciated pieces of wall rock and is sugary in texture. On account of the width of vein and lack of crosscuts, little can be seen here of the walls, but near by the hanging wall is a breccia and footwall decomposed porphyry. Elsewhere, in the workings that are now inaccessible, the footwall is reported to be black slate and gouge, and hanging wall porphyry.

Most of the work was on the Brown Bear claim. The longest and lowest adit runs west 900 feet from near middle of the claim. In the caved section an ore shoot 70 feet long and 16 feet wide is said by Cleaver to have averaged $15 a ton. Outside of this shoot vein is reported to be two to six feet wide and low grade. The next adit is 80 feet higher and is a crosscut for 70 feet, then drifted on vein for 450 feet or more. The vein has a reported average width of six to eight feet, though widening to 38 feet in one place. A stope only 35 feet long was worked here, vein being low grade. The Blacksmith adit is 60 feet above the last named, and 300 feet long. The best ore was stoped out years ago above this adit.

The production of $35,000 from Crystal claim is reported to have been from a 'big bunch' of quartz, from which the sulphides assayed well, but which paid $8.10 per ton in free gold in the mill. This quartz body was entirely worked out, apparently. The last production from the mine was in 1909.

A pipe line 700 feet long and flume of 900 feet would deliver enough water to furnish power for the mill for three months annually, and enough for battery purposes all the year. There are a few small buildings, but no equipment besides the 4-stamp mill and three-foot Pelton wheel.

Columbia Mine. Owner, Adrian J. Fisher. This contains 23 acres, patented, in Lot 2, Sec. 1, T. 45 N., R. 10 W. Base ore containing gold, copper and lead, occurs in a vein one to three feet wide. It was mined by crosscut and drift years ago, and ore was crushed in a 10-stamp water power mill on a five-acre patented millsite in Sec. 18, T. 45 N., R. 9 W., on Mill Creek. The Golden Eagle patented claim, containing 20 acres in Sec. 6, T. 45 N., R. 9 W., belongs to the same owner.

Commodore Mine is on Barkhouse Creek, three miles from the mouth, at 3490 feet elevation. A vein two feet wide has been worked by two tunnels and some ore crushed in an arrastra years ago. Two men are employed. H. J. Barton, owner, Yreka.

Bibl: Cal. State Min. Bur. R. XIII, p. 394.

Contact and Bonanza Claims. Owner, B. G. Reedie, Yreka. In Sec. 19, T. 46 N., R. 6 W., in Fools Paradise district 10 miles north of Yreka, at an elevation of 2100 feet.

The Bonanza vein strikes northwest, and Contact vein northeast and they vary in width from two inches to three feet. A depth of 90 feet has been reached and 230 feet driven on Bonanza vein and 60 feet in depth and 100 feet in length on the Contact. The Bonanza was stoped to a depth of 50 feet and for a length of 200 feet.

Corey Brothers Prospect. (*Virginia Cons.*) Owners, Corey Brothers, Callahan. Contains 80 acres in Sec. 29, T. 40 N., R. 7 W., eight miles from Callahan, seven miles being by road. A vein up to eight feet in width is giving some encouraging prospects to the three owners who have been working at the property only a short time. Address, George Corey, Callahan.

Corey Mine in Sec. 30, T. 40 N., R. 7 W., and Sec. 24, T. 40 N., R. 8 W., also belongs to Corey Brothers of Callahan.

Crawfish Gulch Mine. Owner, Sam Bratt, Oak Bar P. O. Forty acres reported to lie in Sec. 18, T. 45 N., R. 10 W., in Oak Bar district, 39 miles west of Hornbrook. Idle.

Bibl: Cal. State Min. Bur. R. XVII, p. 533.

Crawley Mine. In Sec. 22, T. 40 N., R. 8 W., near Callahan. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 830; XII, p 396.

Cub Bear and *Blue Jeans Prospects.* Owner, Siskiyou Syndicate, I. J. Luce, president, 618 Second Avenue, Seattle, Washington. J. O. W. Applegren, Supt. Holdings stated to contain 640 acres, of which 240 acres are patented. Located 17½ miles from Etna Mills, the last 1½ miles being steep trail. In Sec. 9, T. 40 N., R. 10 W. Geologically similar to other properties in the district, carrying some small rich pockets, in the vicinity of which good milling ore occurs. Veins occur in hornblende schist and quartz porphyry and have been prospected by short adits and cuts. Only one man was employed in the winter of 1924–25 and the claims were idle in the summer of 1925. There is a two-stamp mill, erected in 1918.

Dewey Mine. Owner, Dewey Mines Company. Address F. A. Wright, 1744 Franklin Street, Oakland. In Sec. 6, T. 42 N., R. 6 W., twelve miles southwest of Gazelle. Contains 100 acres, patented. The elevation is 6800 feet. A vein striking N 40° E. and dipping 30° SE. has a width of three feet and occurs in granodiorite. Reported to have been a good producer previous to 1907, since when little work has been done. Development consists of a shaft 400 feet deep, a long adit and numerous drifts, raises and stopes. Ore was oxidized in upper levels but becoming base with depth. There is a mill of ten 850-lb. stamps, a Blake crusher, three Wilfley tables and old electric power equipment, all installed about 1898. The mill handled about 25 tons a day and made a recovery of about 75 %. The Dewey Mines Company operated only a short time.

Bibl: Cal. State Min. Bur. R. XIV, p. 831.

Double Eagle and Little Quartz Claims. In Sec. 26, T. 46 N., R. 9 W., near Barkhouse Creek. A pocket mine, in hornblende schist and granitic walls. The reported production was $10,000. H. J. Barton, owner, Yreka.

Bibl: Cal. State Min. Bur. R. XIII, p. 397; XIV, p. 831.

Easter Mine. Owner, Frank Zollihofer, Yreka. One 20-acre claim in Humbug district. A vein four inches to twelve inches wide occurs in granite. The owner working alone ran several hundred feet of drift and crosscut, and a shallow shaft. Water from Rider Gulch furnishes power for an arrastra.

Bibl: Cal. State Min. Bur. R. XVII, p. 533.

Eliza Mine. Owners, R. H. De Witt, Wm. B. Shearer, A. E. Lunker and O. H. Lawson of Yreka. Comprises five claims, 85 acres, in Secs. 4, 8, and 9, T. 45 N., R. 8 W., in Humbug district 15 miles by road northwest of Yreka.

A vein said to average five feet wide strikes north and dips 35° W. between quartz porphyry footwall and diabase hanging wall. The property was first located by D. M. Lash in 1865. It has been developed by five adits, the lowest of which was over 1700 feet long at last report, giving 360 feet of backs. It is claimed this lower adit is in ore averaging $5 a ton in free gold for 1000 feet and that many thousands of tons of ore are blocked out. The past production is said to have been $150,000.

There is an old 10-stamp mill on the property and plenty of timber. In late years work has been limited.

Bibl: Cal. State Min. Bur. R. XIV, p. 831; R. XIX, p. 138.

Enterprise Group. Owners, Geo. E. Townes and W. E. Tebbe, Weed. Comprises five claims, two miles northeast of Sawyers Bar, at an elevation of 3900 feet.

The vein is reported to be 30 inches wide and has been prospected to a depth of 150 feet, by an adit, winze and raise. Only assessment work is done.

Eureka and W. J. D. Prospects (formerly called *Firebug*). Owners, Dunphy Estate, Sawyers Bar, and W. J. Durch, Rollin P. O. On Blue Ridge, one mile north of Godfreys Ranch, a vein two feet wide has been developed by two crosscuts, and several hundred feet of work has been done. There is an arrastra on the property. Only assessment work is done at present.

Evening Star Mine (see *Union Mine*).

Fairchild Prospect is at the head of Long Gulch, west of Hawkinsville. Under lease and option to T. W. Billings and others in 1923, when a good prospect was reported.

Fagundez Mine (see *Humpback Mine*).

Falcon Prospect. On North Fork of Humbug Creek, at an elevation of 3400 feet and 11 miles northwest of Yreka. A vein nine inches wide in granodiorite, strikes northwest and dips vertically.

Bibl: Cal. State Min. Bur. R. XIII, p. 400.

Flag Prospect. In Humbug district, on Sucker Creek. A vein 30 inches wide occurs in granodiorite. It strikes north and dips steeply east. Was being developed in 1922 by J. L. Garrett et al. of Yreka.

Bibl: Cal. State Min. Bur. R. XIII, p. 401; XVIII, p. 297.

Fleetwood and Nannie S. Mine (formerly *Jackson*). In Humbug district, west of Humbug. Was worked by adits, seven of which were driven, developing short ore shoots in porphyry, containing some rich ore.

Bibl: Cal. State Min. Bur. R. XI, p. 446; XIV, p. 832.

Franklin Mine. Comprises 40 acres on Indian Creek, in Sec. 16, T. 44 N., R. 9 W., in Deadwood district, 8 miles north of Fort Jones. A former producer, with a reputed output of $90,000 previous to 1913. The ore is said to have run about $25 a ton. The mine was worked through an adit with drifts and stopes on the vein.

Bibl: Cal. State Min. Bur. R. XIV, p. 832.

Franks and Moncton (see *Osceola Mine*).

Galena Mine. In Humbug district, on divide between Sucker Creek and Middle Fork of Humbug, 12 miles northwest of Yreka. A small producer years ago.

Bibl: Cal. State Min. Bur. R. XIII, p. 401.

Gilfeather Group. Owners, J. B. Nowdesha and J. J. White, Hamburg Bar. This group comprises 3 quartz claims on Collins Creek, which enters the Klamath from the south at a point 2½ miles west of Oak Bar. The claims are on the side of the canyon 2 miles upstream from the mouth of the creek and one-third mile from the creek.

On one claim, 4 adits ranging in length from 40 to 60 feet have been run, and one of the others has been prospected by open cuts. In the uppermost adit the vein shows two stringers 5 inches wide separated by 8 inches of gouge, and in a lower adit vein is 8 inches wide.

Gilta Quartz Mine (formerly *Gold Hill*). Comprises 60 acres, patented, in Sec. 12, T. 9 N., R. 7 E., on ridge between the forks of Knownothing Creek, eight miles by trail south of Forks of Salmon. Owner, G. A. Dannenbrink et al., Etna.

This was one of the best producers of the district, having an ore shoot three feet wide in slate and diorite walls. It is equipped with an old 10-stamp mill which has been operated by steam or water power. In the past 10 years it has been worked only in a small way by lessees. The last operations ended July 4, 1925, when Wahlheim and Burkig, who had been leasing the property and making some production, ceased work.

Bibl: Cal. State Min. Bur. XIV, p. 833; XI, p. 429; XIII, p. 407 (Hungry Hill).

Golden Eagle Mine (formerly *Indian Creek Mine*). Owner, Geo. Milne, Fort Jones. Contains 37 acres, patented, Min. Surv. 4590 in Sec. 11, T. 44 N., R. 9 W., in Deadwood district, 10 miles north of Fort Jones. This property was worked by the Indian Creek Mining Company many years ago. It was opened by shaft and drifts which finally reached a length of 750 feet on vein, giving a depth of 240 feet below the outcrop. The ore was stoped out above this level.

Four parallel veins, striking north, one dipping west and the others east, are claimed to exist. Ore shoots were 200 feet long, and 15 to 36 inches wide, between diabase and quartz porphyry walls. Ore from west dipping vein was said to run $14 a ton, and total past production is claimed to have been about $500,000.

Milne began work in the spring of 1924. There is a six-stamp mill, steam hoist, Giant air compressor and electric power on property.

Bibl: Cal. State Min. Bur. R. VIII, p. 625; R. XIV, p. 832; Field Report, C. McK. Laizure.

Golden Eagle Claim. Owner, Adrian J. Fisher. Contains 20 acres, patented, in Sec. 6, T. 45 N., R. 9 W.

Golden Seal Claim. A pocket mine in Oro Fino district, Sec. 18, T. 43 N., R. 9 W., five miles northeast of Greenview.

Bibl: Cal. State Min. Bur. R. XIV, p. 832.

Golden West Prospect. On Trail Creek, in Sec. 15, T. 39 N., R. 10 W., 13 miles west of Callahan at an elevation of 7000 feet. A well defined fissure vein in schist, reported to be four feet wide and assaying well.

Bibl: Cal. State Min. Bur. R. XIV, p. 832.

Golden and Eveleth Mine (see *Cleaver Mine*).

Gold Hill Mine (see *Gilta Mine*).

Gold Run Mine. A former producer, but idle for many years. Ten miles by trail south of Forks of Salmon, between the forks of Knownothing Creek.

The Gold Run vein averaged 20 inches wide and had an ore shoot which was 20 feet long on the surface, but increased to a length of 110 feet on the upper adit level, 450 feet deep on the dip of vein. South of this, the ore stopped, but a wider orebody was found by crosscutting through the footwall. The Hunter vein averaged 12 inches wide, with an ore shoot from 80 feet to 150 feet long.

The property was equipped prior to 1891 with a 4-stamp mill and small cyanide plant. The working cost was high, but the ore was good grade, carrying gold coarse enough for the most part to amalgamate in the battery.

The geology of this property was covered in the Eleventh Report of the State Mineralogist, pages 429–431, which see. No recent work has been reported.

Goodman Prospect. Owner, Joe Goodman, Happy Camp. This is a quartz prospect on Indian Creek near Classic Hill Mine, north of Happy Camp. Only assessment work is done.

Grizzly Gulch Mine. A pocket mine in Sec. 14, T. 44 N., R. 9 W., in Deadwood district, 10 miles north of Fort Jones, at 7000 feet elevation.

Bibl: Cal. State Min. Bur. R. XIV, p. 833.

Gumboot Prospect is in Sec. 15, T. 45 N., R. 9 W., eight miles east of Scott Bar. Shallow workings showed base ore, carrying some copper.

Bibl: Cal. State Min. Bur. R. XIII, p. 404; R. XIV, p. 833.

Hanson Mine. On North Fork of Knownothing Creek, eight and one-half miles by trail southwest of Forks of Salmon. Contains 60 acres, patented. Owners, Roberts and Hagland.

Narrow veins were worked here between 1880 and 1900. The pay shoots were short, but ore rich, most of the gold being saved by battery amalgamation. The geology of this district is covered in detail in the Eleventh Report of the State Mineralogist, pages 429–431, which see.

In May, 1924, the property was reported under lease and option to a company of Los Angeles people represented by James Farraher, but no activity was reported during 1925.

Hardscrabble Prospect. Comprises five unpatented claims in Sec. 16, T. 40 N., R. 10 W., 22 miles by road from Etna Mills, between Advance and Victory mines. Owners, reported to be A. M. Buley and E. J. Miley, Sr., of Los Angeles, and John Nefroney of Etna Mills. Elevation 5000 to 5400 feet.

Numerous short crosscuts, drifts and raises have been run in the course of many years of prospecting and assessment work, the property having been worked by different prospectors and by Hardscrabble Mining Company in previous years, but without any available record of production. There is no equipment on claims.

Geological conditions revealed by the workings visited are similar to those in the Advance (which see), which adjoins on the north, and Victory, on the south. The most extensive prospecting has been on the Tom Tit claim, which lies along the saddle of the ridge. An adit 372 feet long runs north to N. 20° E. in black schist and the accompanying dikes. This is connected by raise 101 feet long with upper drifts. As the work is all near the crest of the ridge, the north faces are approaching the surface on the north side. These workings show a quartz vein from six inches to four feet wide, carrying calcite, striking north to N. 20° E. and dipping 72° SE. At frequent intervals the vein jumps from one side to the other of the accompanying dike.

The only work at present on the claims is that being done on the north end from the Advance portals.

Hazel Mine (also called *Jillson Mine*). Contains 80 acres, patented, in Sec. 25, T. 47 N., R. 8 W., in Cottonwood district, four miles southwest of Hornbrook. Owner, Hazel Gold Mining Company, Chico. Address I. O. Jillson, 609 Masonic Ave., San Francisco.

This has been the principal quartz gold producer of the district, being credited with a total output of $800,000. It was discovered in 1883 and the present mill was built in 1899. The Hazel Gold Mining Company operated about three years after the mill was built. In later work the ore averaged $30 a ton, but was hard to follow, due to faulting. There are three veins, two of them parallel, in slate. An ore shoot 150 feet long and three feet wide was worked. Development was by a series of five adits, the longest 1500 feet, and several thousand feet of development in all was done.

The equipment includes dwellings, assay office, mill of ten 850-lb. stamps, driven by water and steam power. Water is supplied from Ditch Creek through one mile of ditch.

The property was leased in 1925 to F. A. Gowing of Berkeley and some activity was promised in the autumn.

Bibl: Cal. State Min. Bur. R. XIV, p. 833.

Hegler Mine (see *Oregon Mine*).

Hickey Mine. Ed Hickey, owner, Sawyers Bar. Five claims in Whites Gulch, about 3½ miles by trail from the mouth of gulch, and at an elevation of 4660 feet (main workings). The last productive work on this property was by lessees 12 years ago and the workings are mostly inaccessible. It is reported to have two parallel veins, two inches to 18 inches wide, about 300 feet apart, and striking east. It was worked by adits, the longest 400 feet or less in length, but as no one was found at the property no exact details were available. The man who milled some of the ore reported it occurred in bunches sometimes worth $200 a ton. Reported production $35,000. There is an old 5-stamp mill, in poor condition, on the gulch over a mile from the workings and ore was hauled to it. This mill was run by water power.

Hicks Mine. An old property in Sec. 2, T. 46 N., R. 7 W., seven miles northwest of Hornbrook. A very narrow vein occurs in granodiorite and was worked by an adit. The ore was crushed in an arrastra.

Bibl: Cal. State Min. Bur. R. XIV, p. 834.

Highland (Old Highland). Owners, Foster Brothers. Comprises 60 acres on Trail Creek in Sec. 12, T. 39 N., R. 10 W., 12½ miles southwest of Callahan. Reported leased with option to T. M. Taylor, C. Wilson, J. R. Porter et al., in 1922. There is a 2-stamp water power mill on the property.

Bibl: Cal. State Min. Bur. R. XIV, p. 834.

Highland Prospect. In Sec. 25, T. 46 N., R. 7 W., in Cottonwood district, three miles west of Hornbrook. An ore shoot 125 feet long and 10 feet wide was worked through an adit 1500 feet long. Has been idle recently.

Bibl: Cal. State Min. Bur. R. XIV, p. 834.

Highland Mine. Assessed to A. Nininger. Herman and J. H. Mattern and J. T. Collins are also part owners. Operated for many years under direction of Herman Mattern and Sons of Ashland, Oregon. Property comprises 320 acres, being S½ of Sec. 9, T. 40 N., R. 10 W. It is 20 miles from Etna Mills and 50 miles from Gazelle or Yreka, the last 3½ miles being steep trail, as the mine is at an elevation of from 5500 to over 6000 feet.

The property was not visited by the writer, and the following notes are from various reports believed reliable.

The mine was discovered in 1899 by P. Mussie, who is reported to have produced $147,000 of gold from specimen ore by hand mortaring. He was sued by a relative who had advanced him $30 as a grubstake, and who finally got the entire mine, a half-interest going to the lawyers as their fee. These people erected a 2-stamp mill and produced a large sum. One lot of 1800 pounds of ore is said to have paid $29,000; another of 1100 pounds yielded $42,000. They operated in the summer seasons only for nine years and in 1909 sold the property for $80,000 to Belgium-Bohemian Mining Company, a European company. Between 1909 and 1914, this company is supposed to have produced $280,000 according to Herman Mattern. They took out all easily accessible ore, but were hampered by the war, and did little work after 1914. In 1919, creditors bought the property at sheriff's sale, since when there has been irregular work. Five or six men have been employed during the summer of 1925.

The main vein strikes N. 40° E. and dips SE. and varies from one to six feet wide. The enclosing formations are schist and granodiorite, traversed by dikes, varying from acidic to basic in character. The veins traverse both schist and granodiorite. Two other veins are reported, but unprospected. The main or Highland vein has been worked to a vertical depth of 184 feet, and for a length of 700 feet. Two stopes 60 by 4 by 70 feet have been worked, and high grade ore has been underhand stoped, there being a winze 60 feet deep. The vein contains white 'sugar' quartz, some bluish quartz and calcite. The present mode of operating is expensive on account of the number of times rock must be handled.

Equipment includes a triple discharge 2-stamp mill, with a capacity of five tons per day, which is operated part of the year by a Pelton waterwheel and part time by a 15-h.p. gasoline engine; a 40-h.p. gasoline engine, a 3-drill air compressor, blacksmith shop, bunk house, cook house and office building.

Hoboken Mine. Owner, Estate of H. J. Diggles. Forty acres, patented, in Sec. 21, T. 45 N., R. 8 W., in Deadwood district, a mile and one-half by trail from Cherry Creek road and 11 miles north of Fort Jones. Elevation 4500 feet.

The vein, said to vary from six inches to six feet thick, was worked through three crosscut adits, with drifts on the vein. No. 1 (upper) adit was drifted on vein for a reported length of 500 feet, and ore stoped out above it and worked for the free gold in an arrastra many years ago. The next level, 290 feet below No. 1, opened quite a heavy flow of water on striking the vein, and a third adit was started to drain this. In depth the ore shows 2% to 5% of sulphides.

In 1919, R. N. Diggles reopened the mine and extended the upper adit 100 feet, and also worked in the lower adit. A Gibson mill was installed. In 1922, the property was leased and late that year good prospects from the lower adit were reported.

Bibl: Cal. State Min. Bur. R. XII, p. 284; XIII, p. 406; XIV, p. 835; XVIII, p. 496.

Homestake Mine. Owner, R. S. Taylor, Yreka. Under lease and option to purchase by Homestake Consolidated Mines, Inc. President, A. T. Maning, 2113 Third avenue, Seattle. Secretary, J. B. Macdonald, 923 Birks Building, Vancouver. J. A. Maguire, superintendent.

The property is in the southern part of T. 41 N., R. 10 W., on west side of North Russian Creek, 16 miles by road southwest of Etna, at an elevation of 4200 to 4800 feet.

Formations are quartz porphyry, dioritic schist and muscovite schist, similar in general to the formations at the Highland mine. The property has been a small producer of specimen rock since 1902, and some milling has been done, the vein material close to the 'high grade' being of good mill grade. The 'high grade' occurs in a greyish, fine-grained muscovite schist. The ore being milled at time of visit was black schist ore, carrying a reported content of $20 a ton, mostly free gold, with one or two per cent of auriferous pyrite and galena. A few thousand dollars production was made during 1925.

The present company began work in November, 1924, and in October, 1925, had 10 men employed, most of them outside preparing for winter. The mill of two 1200-lb. stamps has been operated since August, 1925. Water for power and other uses comes from Taylor Creek through 800 feet of ditch and 260 feet of six-inch pipe. There is a two-drill compressor. Besides the mill there is an assay office, boarding house and several buildings. The *Hogan* property, adjoining, is also under lease to this company.

Humpback (Fagundez) Quartz Mine. Owner, Rollin L. Fagundez, Merced. Contains 80 acres, patented, in Secs. 4, 5, 8, 9, T. 39 N., R. 11 W., on ridge between two forks of Eddys Gulch three miles by road and trail from Sawyers Bar. Claims are Azores No. 1 and No. 2, Humpback Quartz Mine, two placer claims and two millsites.

During the early nineties this property was equipped with a five-stamp mill and was one of the best producers of the district. The vein is said to have ranged from three inches to twelve inches wide, and a man mined only about one-half ton a shift, but the ore was rich and pockety, yielding $30 to $200 a ton in the mill. It is locally credited with a gross output of $260,000. Idle for many years.

Bibl: Cal. State Min. Bur. R. VIII, p. 619; XI, p. 432; XII, p. 281; XIII, p. 386; XIV, p. 835.

Ida May Quartz Mine. Owner, A. J. Ball, Rollin P. O. Comprises Ida May, Frances Bell and Lucky Strike quartz claims, 54.2 acres at Rollin, four miles by road south of Sawyers Bar and at an elevation of 3700 feet, on ridge between two forks of Eddy Gulch.

The vein occurs in the black crushed slaty schist of the district, and strikes southwest, with a flat dip averaging about 22° northwest. On the footwall side the black graphitic schist has been ground to a putty-like gouge from two feet to fourteen feet thick, carrying considerable broken quartz. This gouge swells on account of its limestone content, requiring good timbering and close lagging in places. The slaty schist formation common to practically all the mines of this immediate district appears as a flat blanket deposit which has been ground to gouge along its contact by local movements. The vein is said by the owner to average four feet wide in the pay shoots, but the workings in ore are mostly inaccessible on account of caving, and the present work was not yet in permanent vein matter, although quartz was coming in.

The vein has been prospected and ore developed by a series of adit levels only a short distance apart vertically, but giving considerable backs because of the flat dip of vein. No. 1 level was 252 feet long and No. 2 was 160 feet long, and Ball states that from these levels and their stopes he has produced 2000 tons of ore yielding $45,000. This was oxidized ore, and sulphide ore was not struck until a depth of 400 feet on the dip was reached, within 60 feet of the face of No. 3 level. This latter level was run 321 feet northwest then southwest 230 feet on the vein from the Ida May into the Frances Ball claim. Crosscuts on each side from this drift were run diagonally across vein for 60 feet. Off No.

3 adit 160 feet in, a drift runs 120 feet a few degrees south of east, to a raise 40 feet high into vein, which was followed up on dip 160 feet above No. 3 adit. Ball states this level has produced $25,000. On account of the crushed condition of the ground, nearly all underground work is by hand picking, very little explosive being used.

No. 4 level is 28 feet vertically, or 90 feet on dip, below No. 3 and was 384 feet long, with the heavy footwall gouge showing in face at time of visit in September, 1925. A raise and intermediate level above No. 4 was showing broken quartz.

There is a two-stamp mill on the property which is operated in season by water power and four men are employed. The old Klamath mill, containing 19 stamps, adjoins.

Independence Mine. Owner, Buzzard Hill Mine, Incorporated, a Delaware corporation, with an office at Mt. Kisco, N. Y. H. C. Cutting, president and general manager, Happy Camp. The Independence holdings comprise seven quartz locations, covering 4500 feet along the strike, on Independence Creek in Sec. 32, T. 15 N., R. 7 E., 4000 feet southeast of Klamath River and 14 miles by road south of Happy Camp. Elevation 1225 feet. Hornbrook, the nearest railroad station, is 87 miles east.

Rich ore was first found on this property about 1895 by Joe Biggs, who extracted $6,000 and sold out. The property changed hands several times, each succeeding owner believing he had the best part of the gold in the property before he sold it. Stock & Kleaver are reported to have produced $10,000 and Jack and Claude Zachary and Wm. Kleaver, the last owners before the present company, are credited with having taken out $60,000. H. C. Cutting claims that his company had produced over $100,000 up to August, 1925. The early work was mostly in a shallow shaft known as the 'grubstake hole,' on the apex of vein a short distance above the present adits.

The vein strikes N. 42° W. and dips 56° to 70° SW. in the lower workings but at the discovery point dips northeast. The ore so far developed has been found in a lens of quartz 150 feet long, varying from one foot to five feet wide, and averaging three feet wide. The country rock is ancient basic schist, gabbro and diorite, classified as pre-Cambrian by J. P. Smith.[1] Serpentine forms the immediate walls of the vein, and a horse of the same rock fills a large part of the fissure. On the hanging wall side of the vein numerous vugs of all sizes occur, where part of the rock has been leached out leaving quartz and soft seam filling. But although the hanging wall side of vein showed several good bunches of specimen ore at the time of visit, it was said the footwall had yielded most of the gold.

The vein has been proved on the strike for 700 feet. Besides the Discovery or Grubstake shaft, two adits, the upper 180 feet long and the lower 230 feet long, had been run prior to time of visit in July, 1925, giving a depth of about 100 feet on the vein, and a winze which was full of water was said to be 50 feet deep below the lower adit. High grade ore, some of it well filled with gold, was followed down from the shaft and was picked up in the adits and followed up in raises. It is 52 feet on the vein from No. 2 to No. 1 adit. In the upper five feet of a raise run here to pick up the downward extension of specimen ore found in a 14 foot winze from the upper adit, it is said $43,000 in 'high grade' was removed. Below here in this raise, called East Raise No. 1, an unknown but probably smaller amount of such ore remained. Forty feet distant in West Raise No. 1 high grade ore also showed for 15 feet or more above the adit. Such ore is also reported in the bottom of the Grubstake shaft above No. 1 level, and in the winze 50 feet below No. 2 level, these being about midway horizontally between the raises.

---

[1] J. P. Smith, Geologic Map of California, Cal. State Min. Bur., 1916.

A private road 4000 feet long from the camp at the river to the mine workings was being built in July, 1925. Water is obtained from Independence Creek, which runs nearby and parallel to the vein. A new flume 6000 feet long to have a capacity of 500 cubic feet a minute and a head of 220 feet at the mine, was planned. The company also planned to bring a ball mill of 50 tons capacity from the Buzzard Mine, and install a water wheel, air compressor, drill sharpener and other equipment. Fifteen to twenty men were employed. There is plenty of timber near the mine.

A quantity of rich specimen ore, estimated to have contained over $25,000 in gold, was taken from the mine in August, 1924, and caused a sensation when shown in the State Mining Bureau's exhibit at the convention of the American Mining Congress at Sacramento that year.

Tests on ore from the lower adit have indicated the possibility of profitably milling the quartz outside the specimen ore shoots.

Inyo Mine. Comprises 20 acres in Sec. 2, T. 45 N., R. 8 W., in Humbug district 11 miles west of Yreka. An old pocket mine, with a production of $4,000 previous to 1913.

Bibl: Cal State Min. Bur. R. XIV, p. 835.

Ironsides Mine. In Sec. 26, T. 45 N., R. 8 W., seven miles southwest of Yreka. A pocket mine.

Bibl: Cal. State Min. Bur. R. XII, p. 285; XIII, p. 408; XIV, p. 835.

Johnson and China Paul Mine. A pocket mine in Sec. 12, T. 43 N., R. 10 W., in Quartz Valley district.

Bibl: Cal. State Min. Bur. R. VIII, p. 826; XIV, p. 835.

Jumbo Mine (Ruby Basin). Owners, Geo. E. Towns and W. E. Tebbe, Weed. Five claims in Sec. 1, T. 39 N., R. 11 W., in Whites Gulch, 1½ miles above the mouth by trail and 4½ miles from Sawyers Bar.

It was a small producer 20 to 25 years ago, an ore shoot reported 160 feet long and three feet wide having been milled. It was sold by Cullberg to the present owners about 1914. They spent $12,000 but crushed no ore, and mine has been idle in late years. It is said that the ore slimed excessively, and recovery was only about 20% by amalgamation. The mill contains 10 light stamps formerly operated by water power, but has been idle for 20 years or more and is in poor shape.

Bibl: Cal. State Min. Bur. R. XIV, p. 840.

Kangaroo Mine. A pocket mine, in Sec. 29, T. 40 N., R. 7 W., nine miles southeast of Callahan.

Bibl: Cal. State Min. Bur. R. XIV, p. 836.

Katie May Mine. In Greenhorn district, Sec. 24, T. 45 N., R. 8 W., and contains 20 acres. Was worked by an adit and 80-foot shaft, and ore was stoped four feet wide, 60 feet long and 50 feet high. It was sufficiently high grade to haul many miles to a custom mill.

Bibl: Cal. State Min. Bur. R. XIII, p. 409; XIV, p. 836.

Keynote Group. Owners, C. E. Weston, Yreka, Charles G. Peterson, 1825 Oak Street, San Francisco, and Charles Magill, c/o Land Department, Southern Pacific Co., San Francisco.

This comprises six unpatented claims in Sec. 30, T. 34 N., R. 6 W., Fools Paradise district, six miles north of Yreka near Shasta River. Gold bearing quartz was discovered by Horace Howe in 1922 and the claims were leased to W. E. Anderson. Soon afterwards 75 tons of ore was mined and hauled to Yreka where it was crushed in a custom mill and according to a report by Magill, yielded $22.50 a ton in free gold. This ore came from a length of 40 feet and depth of 40 feet on the vein. The vein has been developed for a length of 600 feet by a series of short adits and open cuts. The maximum depth prospected is 175 feet below the apex on the hillside. The workings so far have been in the surface oxidized zone, and show an igneous dike on one wall. No work is being done at present.

King Solomon Mine. Owner, Edgar H. Cottrell, Westerly, R. I. Mineral Survey 4532 in Secs. 13 and 14, T. 38 N., R. 12 W., at head of Mathews Creek, three miles due northwest of Cecilville at an elevation of 3500 feet. This property was a good producer previous to 1914 but has been idle lately. A shallow orebody was mined and milled in an eight-stamp mill.

Bibl: Cal. State Min. Bur. R. XIV, p. 836.

Kinkaid Prospect. Owner, John Kinkaid, Sawyers Bar. One unpatented quartz location on Jackass Gulch, five miles by trail from the mouth of the gulch and seven miles north of Sawyers Bar. This is equipped with a small Ellis Chili mill. Kinkaid also has two unpatented quartz locations four miles by steep trail from Sawyers Bar at the head of Jessops Gulch. So far only surface prospecting has been done on a disseminated deposit at the latter place and there is no equipment. In years past some gold pockets containing pieces worth as much as $50 each have been mined in a small serpentine area at the head of Jessops Gulch.

Klamath Group. Owner, A. J. Ball, Rollin P. O. Contains four quartz locations named Mabel, Protection, Arctic and Zero, being relocations of Ada, Flora Blanch, Ohio and Buckeye claims, respectively, of the old Klamath Mine, a former producer, situated on ridge at the head of Eddys Gulch, elevation 4240 to 4800 feet, and 1½ miles southwest of Rollin P. O. by road.

The main vein on this group and that on the adjoining Central and Mountain Laurel mines on the north no doubt are on the same fissure, although between the Klamath and Central there has been a narrowing of the fissure where no ore has been found for some distance, as shown in the Central workings.

The black slaty schist or 'slate' as it is called locally, is the most important formation in the district, carrying practically all the payable veins. The Klamath vein strikes between north and northeast and dips from 5° to 45° southeast, at an angle to the schistosity of the enclosing schist. In both walls close to the vein, occur bunches and lenses of light colored porphyritic intrusive rock, usually entirely altered in place, and locally called 'cab.' The strongest veins in this district have pronounced post-mineral gouges, as noted in the Central, Ida May, and other workings. There are said to be two or three overlapping strata of quartz separated by horses, in some of the old Klamath workings. The width of vein and of ore varies from two feet to 24 feet, and in places selective mining has been done, leaving bodies of good looking but probably low-grade quartz.

The Ada and Flora Blanch claims were first operated in 1863–65 by the Union Mining Company which had an eight-stamp mill and is said to have produced $59,400. Between 1870 and 1881 the Klamath Mining Company mined and milled 33,680 tons, which yielded $418,549 and specimens worth $25,000. In 1883, $30,000 was produced. These figures were largely substantiated by C. W. Raymond who made numerous assays and measurements of old stopes in 1906.

Later records are less exact, as this mine and the Mountain Laurel were subsequently operated jointly by several companies, and ores from both were milled in the same 20-stamp mill at Rollin. The old mill handled only about 20 tons in 24 hours. The Gold Ball Consolidated Mining Company between 1887–95, the Yreka Mining and Milling Company about 1900–06, and the California Consolidated Mining Company up to 1910, all operated the two groups but worked principally in the Mountain Laurel. Yreka M. & M. Co. mined and milled 23,300 tons which yielded $184,000 from the two groups in five years up to 1906, according to Raymond.

There remains in the Klamath Mine according to A. J. Ball, considerable low grade ore. The stoped width of ore varied from two feet to six feet as a rule, and value per ton ranged from $5 to $12 but must have averaged nearer $12 a ton if production figures are correct. The average tailing loss was estimated at one dollar in free gold and eighty cents per ton on account of not saving concentrate. The mine was worked by a great number of adits, and stopes varied in length from 50 to 400 feet on the strike. In later years a tramway was built from the mine to the mill, but all equipment is at present in a state of decay.

Lanky Bob Mine. Owner, Denny Bar Company, Etna. On East Fork of Whites Gulch, five miles by road and trail from Sawyers Bar.

This was formerly a producer, but has been idle for several years. Its output was possibly $50,000. Under lease and option in 1925 to Thomas Salisbury. There is an old mill on the claims.

Little Bonsa Mine. Owner, C. W. Gordon, Yreka. Thirty acres in Sec. 9, T. 45 N., R. 7 W., four miles northwest of Yreka, at an elevation of 3600 feet. This is a pocket mine, with one vein striking east and another northeast. Production to 1920 was about $8,000, which was taken out by the owner, working alone.

Livingstone and Everton Pocket Mine. Owner, T. E. Ahlstrom, Ashland, Oregon. In Happy Camp district.

Lucky Strike Mine (see *Osgood Mine*).

Malloy Quartz Mine (Oregonian Group). Owner, Dan Malloy, Sawyers Bar. Includes Snowbird, Gold Bug and other claims on the south side of Tanners Peak, at head of Rattlesnake Gulch at an elevation of 5000 feet and 3½ miles by road and trail from Sawyers Bar.

A vein six inches and upward in width occurs in granite, and has been prospected and mined in a small way, with considerable production of gold, for the past 40 years. Malloy works alone most of the time, and makes an occasional crushing of ore in the 3-stamp mill, which is operated by a gasoline engine. The mine is opened by adits.

Bibl: Cal. State Min. Bur. R. XII, p. 289; XIII, p. 419; XIV, p. 838.

McClaughry Group. In Sec. 8, T. 45 N., R. 8 W., in Humbug district.

Bibl: Cal. State Min. Bur. R. XIV, p. 837.

McKeen Mine (see *Oro Grande*).

McKenzie Mine. Owner, W. H. Herndon, Gottville. It is on Lum Grey Creek, 5½ miles by road and trail from Gottville. There is a 2-stamp mill on the property. It was active in the summer of 1925.

Mosher & Lowell are working a quartz claim on Horse Creek one-fourth mile from Barnum Bros. They have been developing the claim for two years and have a 10-stamp Straub mill.

Wm. Might has a group of claims on Indian Creek near Classic Hill Mine, where he has been prospecting for several years. He has no equipment except hand tools.

Monarch Quartz Mine. Owner, L. W. Godfrey, Sawyers Bar. This comprises four claims on Methodist Creek, seven miles above the mouth.

A quartz vein, stated to be up to 10 feet in width but of pockety character, has been developed by a series of short adit levels, raises and stopes, the longest adits being 200 and 300 feet in length. There is a 2-stamp mill on the property which is operated by water power and the total production of the property is said to have been about $12,000.

Morrison and Carlock Mine (formerly *Little Queen*). Owner, Reichman Mercantile Company, Fort Jones. It is in Quartz Valley district, four miles northwest of Greenview, at an elevation of 2800 feet, and contains 60 acres of patented land.

This was the best quartz producer of the district but has been idle since 1907. It is credited with a production of about $500,000. Previous to 1900 the ore was worked in an arrastra but later a 10-stamp mill was built and the mine was developed by a shaft to a vertical depth of 400 feet, with eight levels, the longest drift reported 1200 feet southwesterly. There was also an old adit 1500 feet long.

The mine was under lease and option in 1925 and was being unwatered in the autumn. L. C. Monahan, superintendent. The equipment includes an old steam hoist, 10-stamp mill, electric power, dwellings and assay office.

Bibl: Cal. State Min. Bur. R. XIII, p. 413; XIV, p. 837.

Mountain Laurel Quartz Mine lies at the head of the left fork of Eddys Gulch, five miles by road south of Sawyers Bar at an elevation of 3600 to 4000 feet. It was one of the producing quartz mines of the district for many years, but has been idle since the last work was done by F. A. Gowing in 1922.

The vein, which strikes north to N. 40° E. and dips 5° to 60° SE., occurs in the black, slaty graphitic schists which carry most of the gold ores of this district. It has been prospected and exploited by a series of six adit levels. The principal production in later years was by the Yreka Mining and Milling Company up to 1906, and by the California Consolidated between 1906 and 1910.

The May adit at 3810 feet elevation was run 535 feet southeast, then drifted 130 feet southwest and 280 feet northeast, but was not productive of ore. The Mi adit, 60 feet above and 280 feet east of May adit, cut the ledge 200 feet from the portal and followed it 140 feet northeast and 250 feet southwest. Ore of good grade, from three feet to six feet wide, was stoped on the southwest nearly to the surface. Mj adit, elevation 3870 feet, is 520 feet southeast of the north end of Mountain Laurel claim and 400 feet east of the west side line. It cut the vein 270 feet from the portal, and a small chamber of high grade ore found near here is said to have yielded 60 tons of ore worth $7,000. In all about 2300 tons was stoped from this level. About 590 feet from the portal a winze was sunk 180 feet to Stevens tunnel level, and levels called 90, 100 and 150 levels were run northeast under the Wisconsin Claim. On the 100 level, 8800 tons of ore averaging 5½ feet in width and $18.40 per ton is reported to have been mined. The ledge generally has a flat dip and the 100 level was only 42 feet vertically below the adit. The Stevens tunnel was a long lower level from which a great deal of work was done. Due to the long time since this mine was discovered, the various companies concerned, the loss of records, and the fact that the mine was worked at times in conjunction with the nearby Klamath, using the same mill, it is impossible to accurately determine its output, but it probably produced over $600,000 from ore averaging $8.50 or better a ton. The California Consolidated Mining Company is said to have produced $90,000 between 1906 and 1910.

The Mountain Laurel unpatented ground has been relocated, in part by A. J. Ball of Rollin, who holds four claims, formerly known as the Liberty, Wisconsin, Illinois and Golden Eagle, and in part by William Wike of Sawyers Bar. Only assessment work has been done the past few years. There is an old 20-stamp mill, fitted for operation by water power, on patented ground at Rollin.

Mountain Lily Quartz Mine. Owner, G. A. Conzetti, of Cecilville. Property comprises seven claims, a six-stamp mill and arrastra. The principal vein has been traced 6000 feet and prospected to a depth of 150 feet. Idle.

Bibl: Cal. State Min. Bur. R. XVII, p. 534.

Mount Vernon Consolidated Mine. Owners, James S. Dobyns and Cora N. Jacobs, Yreka. Comprises four patented claims and one unpatented claim, 75 acres in all, in Sec. 26, T. 45 N., R. 8 E., eight miles west of Yreka by good road, at an elevation of 4434 feet.

These claims have been worked irregularly for over 50 years. They cover 3000 feet on the strike of two veins, and have been prospected by adits which give a maximum depth of about 600 feet below the outcrop. On 100, 200 and 300 levels, the vein has been drifted from 400 to 500 feet, and has been stoped out above 300 level. The lowest level has been run 800 feet with a raise of 100 feet. The veins strike north and northwest and ore shoots are said to have varied from 30 to 60 feet in length and had a width of about 14 inches.

The mine has been worked by several companies and the total output is unknown. The equipment consists of 5-stamp mill, built in 1904, operated by electricity, using 20-h.p. motor; Blake crusher, with 15-h.p. motor; air compressor and drills, with 20-h.p. motor, and ore car, blower and tools. There is plenty of timber, and water sufficient for milling.

The ore is said to run from $4 to $25 a ton with some high grade, and concentrates carry from $40 to $80 a ton. The last work was in 1918–19 by Mt. Vernon Gold Mining Company.

Mountain King Group. Owner, D. C. Weaver, Orleans. Three claims in Prospect Hill district, 12 miles north of Orleans, at 4000 feet elevation. This is a prospect located in 1918.

Neilon and *Putnam Prospect.* Miles Neilon and W. Putnam, owners, Sawyers Bar. On Counts Gulch (a tributary of Whites Gulch) 1½ miles from the mouth and 4½ miles from Sawyers Bar. A prospect discovered in 1921. Contains two claims on which only superficial work has been done. Said to show a vein up to four feet wide, prospecting well. A few tons of ore have been crushed in a small Chili mill..

The claims were leased with option in 1925 to Thomas Salisbury.

New York Mine. Owner, J. B. Scott, Brownsville, Texas. M. C. Beem, agent, Fort Jones. Mineral Survey 4134 in Sec. 2, T. 44 N., R. 9 W., nine miles north of Fort Jones at an elevation of 3300 feet. Contains 77 acres, patented.

Parallel veins and seams of quartz strike N. 20° E. and dip nearly vertically, with numerous faults, cross veins and stringers. The mine was first worked on the surface in 1856, when pockets were mined. Formations are diorite and porphyry. Average width of pay ore is said to have been two feet, and values were spotted in the lower levels.

A depth of about 800 feet on an incline of 45° is said to have been reached. The monthly production at one time was from $6,000 to $10,000, according to J. A. Hight. Equipment includes a steam hoist, air compressor, boilers, 10-stamp mill and two concentrators, and electric motors.

Nigger Boy Mine. In Sec. 2, T. 46 N., R. 7 W., five miles southwest of Hornbrook. It was developed prior to 1914 by two adits, 1000 feet and 80 feet long, and an ore shoot was claimed to have been opened. In 1921, A. D. McCullough had an option on three-fourths interest in the property and was driving a new crosscut adit. Equipment includes dwelling, tools, shop and 2-stamp mill. Water is obtained through a ditch a mile and one-half long from Ash Creek.

North Star Mine (Boyle Mine). In Sec. 8, T. 45 N., R. 8 W., in Humbug district 14 miles from Yreka. This was one of the principal producers of Humbug district, where the ledges were generally small and worked only to water level, for the most part. This mine was equipped with a 4-stamp mill and a Huntington mill over 35 years ago and at that time employed 20 men. It was developed by a series of adits to a shallow depth and yielded ore running $20 to $100 a ton.

The operations were described in detail in the Eleventh Report of State Mineralogist, pages 444–445, which see. Some repair work was done in 1921–22 on the mill and buildings.

Ohio Mine. In Sec. 8, T. 46 N., R. 6 W., Fools Paradise district. Sixty acres, patented.

Bibl: Cal. State Min. Bur. R. XIV, p. 838.

Old Vet and Eclipse. In Secs. 10 and 11, T. 45 N., R. 8 W., in Humbug district.

Bibl: Cal. State Min. Bur. R. XIII, p. 418, XIV, p. 838.

One Hundred Dollar Prospect. Owners, Sam Wallace, Frank Smith and Wm. Perkins of Sawyers Bar. This is a recent discovery on the top of Tanners Peak, five miles by road and trail north of Sawyers Bar, and at an elevation of 6500 feet. A vein six inches wide is reported to give flattering prospects but no development has been done yet, although the claim has changed hands several times.

Oregon Mine (Hegler and Aldrich Mine). Ed Mathewson, owner. On Lawson Gulch, in Sec. 3, T. 45 N., R. 8 W., in Humbug district, at an elevation of 3800 feet.

This property was worked, beginning 35 years ago, by three adits 80 feet apart, the lowest a crosscut 180 feet long, with 720 feet of drifting on the vein. The ore was milled in a 5-stamp mill, using steam power. The vein strikes northeast and dips steeply east. It was said the vein averaged $5 a ton in free gold and was two to six feet wide. A new crosscut adit was started in 1923 to search for the vein below the old workings. It was expected this would have to be 900 feet long.

Bibl: Cal. State Min. Bur. R. XI, p. 446; XIII, p. 405.

Oregonian Group (see *Malloy Mine*).

Oriental Quartz Mine. Owner, John Joseph, Sawyers Bar. At the head of left fork of Eddys Gulch, one-half mile from Rollin, and adjoining the Boss Mine. This claim has been worked for many years in a desultory way, and made some production years ago. The present work is in an adit which is being run N. 55° W. at an elevation of 3900 feet, and had reached a length of 112 feet at the end of September, 1925. A vein two to three feet wide with a very heavy gouge on the hanging wall was cut near the face. It lies nearly flat and both walls are black, slaty graphitic schist. The heavy gouge was probably caused by hillside drag along the plane of the vein. One man employed.

Oro Grande Mine (McKeen or Shasta Mine). Owner, Oro Grande Mg. Co. J. R. McKinnie, president. Office, 637 Citizens National Bank Building, Los Angeles. H. McKinnie, secretary. Contains 473 acres patented, and 200 acres, unpatented, in Sec. 36, T. 40 N., R. 9 W., in Callahan district. Gazelle, the nearest railroad station is 31 miles northeast. Elevation is 4000 feet.

Five veins occur in granodiorite. They strike northeast and the principal one dips 85°. It varies from 18 inches to four feet wide, averaging two feet. Development consists of five adits, giving a vertical depth of 400 feet below the outcrop, a maximum length of 3000 feet on the vein and a total footage of 8000 feet of tunnels and 300 feet of raise.

The production previous to present company is reported to have been $500,000 for about one-half of which there is a definite record, but none for the product of arrastras and former 3-stamp mill. The present company ran the mill only for experimental purposes but have done nothing since 1916. Most of their work was done underground, and J. R. McKinnie claims about 50,000 tons of ore proved, which ranges in value from $5 a ton on the lowest level to over $11 a ton on the next level 193 feet higher, where the vein was sampled for 400 feet. The average value is thought to be $7 or $8 a ton.

The mine equipment includes shop, compressor building, warehouse, sawmill, bunkhouse and boarding house for 50 men, a 4-drill compressor and air drills.

The milling plant contains Blake crusher, 100-ton ball mill, Senn amalgamator, K. & K. flotation machine, tanks and zinc boxes.

A good water right is owned on Boulder Creek and there is ample good timber.

Oro Grande Mine. Owner (at last report), Trask and Corinson. In Secs. 10 and 11, T. 45 N., R. 7 W., in Humbug District. Contains 100 acres, with four parallel veins having dolomite footwall and porphyry hanging wall. It produced $20,000 previous to 1914, ore having been worked by a shaft 160 feet deep and adit 300 feet long with a stope 80 by 4 by 40 feet.

Bibl: Cal. State Min. Bur. R. XIII, p. 419; XIV, p. 838.

Osceola Prospect. James Keaton, owner, Sawyers Bar. Three quartz locations on mountain between Whites Gulch and Counts Gulch, five miles by road and trail from Sawyers Bar and between Uncle Sam and Hickey Mines.

This prospect once belonged to Sheffield, formerly owner of the Uncle Sam Mine, but he abandoned it. A millman who milled two lots of ore totalling 150 tons from the claims states it averaged $6 a ton. Keaton bought the claims from J. Johnson. This property was not visited by the writer, but is stated to show a large low grade dike of porphyry and quartz, panning gold. It strikes southwest and dips southeast. It has been prospected by two adits, 125 feet and 150 feet long, one drifted on the vein 60 feet. A third and lowest adit 340 feet long has not yet reached the vein according to Keaton.

Osgood Mine. Lessees, Judson C. Hubbart et al. Situated two miles west of Yreka. Elevation 2800 feet. Holdings consist of eleven claims.

Several different vein systems occur in a belt of metamorphic slate, porphyry and schist, striking north and south, with the general trend of the range, and dipping almost vertically. The belt is interrupted and broken in many places due to local disturbances. The auriferous veins follow the strike of the belt, and are usually of narrow widths. Four of these vein systems have been cut by a crosscut tunnel 116 feet in length, the pay streaks occurring in narrow seams and fractures in the zones. Oftentimes the quartz is entirely lacking in the veins, the gold being deposited along fractures in the rock. About 90 per cent of the values occur as free gold, little pyrite being found. The limits of the ore zone are well defined and are determined by panning. Most of the work is confined to the 150-foot shaft, from which it is reported over $10,000 was taken. The shaft is intersected by a tunnel at a depth of 150 feet. Considerable stoping has been done from the 100-foot level to the surface, where the vein was evidently of good width, while little work has been done below that level.

Equipment consists of blacksmith shop, assay office, 5-stamp mill, with 1050-lb. stamps, and amalgamation plates. Mill is driven by 30-horsepower motor.

The property was leased with option to J. C. Hubbart et al. in 1916 and sampling and mill tests were carried on by Hubbart until 1921, work being done on the *Spring Gulch*, *Wacker* and other claims as well as on the Osgood. All of these claims and others, have been consolidated by Hubbart under the title of Empire Mining and Milling Company, of which Hubbart is superintendent. This company has offices at Yakima, Washington. They have not been working on the claims.

Bibl: Cal. State Min. Bur. R. XIX, p. 138.

Outlook Mine. Owner, Outlook Mining Company, Happy Camp. Four unpatented claims in Sec. 4, T. 15 N., R. 7 E., H. M., seven miles by road south of Happy Camp, on south side of Klamath River.

These claims are reported to be on the northward extension of the Buzzard Hill vein. A small amount of work has been done one-half mile north of the Buzzard Hill workings. This work consists of an open cut across the vein, two short adits and an incline 30 feet deep, the total amounting to 100 linear feet. The vein is said to be the same in character as at the Buzzard, with same dip and strike, and similar values. The depth of oxidation is shallower, and copper has been noticed in the sulphide.

Overton Mine. In Sec. 16, T. 40 N., R. 10 W. Owner (1913), Overton Gold Mining Company.

A small producer up to 1914. The ore was packed on mules two miles to the Advance mill on Russian Creek. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 838.

Pilot Knob Mine. Owner, Pilot Knob Mining Company (lapsed as a corporation). Secretary, T. K. Anderson, Gottville, is a principal owner. Contains 15 quartz locations on Empire Creek, three miles by road from Gottville and 20 miles from Hornbrook. Title uncertain for some claims.

This is a large, low grade deposit, gold occurring in stringers of quartz and in the schist. It was first found in 1882 and some work was carried on up to the time of the war, since when the property has been idle until 1920 on account of high costs. In 1920, considerable prospecting was done. A vertical depth of 200 feet below the outcrop was reached in an adit 500 feet long, but other short adits have prospected the surface 600 feet below the apex of hill. Various mill tests over a width of 400 feet are reported to show up to $4 a ton, but probably in general the rock is lower grade than that.

Equipment consists of 5-stamp mill fitted to operate by water power or gasoline engine, being belted at present to a tractor engine. Empire Creek passes the mill but carries little water in summer. There are several buildings on the property.

Pilot Knob & Kearsarge Claims (Midwinter & Modoc). Owner, R. G. Reeder, Yreka. Two claims in Sec. 30, T. 46 N., R. 6 W., ten miles north of Yreka.

Two veins strike north and east, respectively, and vary from a few inches to three feet wide. Midwinter vein has been worked through four short adits and two shallow shafts and Modoc vein through two adits. A few thousand dollars production is claimed.

Bibl: Cal. State Min. Bur. R. XVII, p. 535.

Porphyry Dike. Owners, Mr. and Mrs. Charles Slater, Callahan. One claim in Sec. 18, T. 40 N., R. 7 W., in the East Fork district, 23 miles from Gazelle.

This claim was equipped in 1921 with a small ball mill. The dike carries some gold and occurs along the serpentine contact. Elsewhere in this district, dikes of which the upper parts have been oxidized and softened by weathering, have been worked by hydraulicking.

Prospect Hill. In Sec. 30, T. 12 N., R. 6 E., 11 miles north of Orleans. There is a 3-stamp mill on the property, which has been worked by adits and has made some production.

Providence Mine. In Sec. 18, T. 43 N., R. 9 W., in Oro Fino district five miles northeast of Greenview. Formerly worked as a pocket mine.

Bibl: Cal. State Min. Bur. R. XIII, p. 421; XIV, p. 839.

Quartz Hill Mine (see under Gold Placer Mines).

Rainbow Mine. Owners, T. C. Quin and Newton Gordon, Hawkinsville. A good prospect of free gold was reported in a crosscut 90 feet long, 50 feet below the surface. Some work was done in 1922–23.

Bibl: Cal. State Min. Bur. R. XVIII, p. 733; XIX, pp. 58, 93.

Red Hill Mine. In Sec. 4, T. 45 N., R. 7 W., five miles north of Yreka. It was formerly a small producer, ore from a narrow vein having been hauled to Yreka for milling.

Bibl: Cal. State Min. Bur. R. XIV, p. 839.

Reeder Group. In Sec. 8, T. 46 N., R. 7 W., in Fools Paradise district 6½ miles southwest of Hornbrook. Reeder produced considerable gold from pockets, working alone. The total output previous to 1914 was estimated at $50,000.

Bibl: Cal. State Min. Bur. R. XIV, p. 840.

Robinson Gulch Prospect. In Sec. 18, T. 40 N., R. 10 W. A pocket mine, not recently active.

Bibl: Cal. State Min. Bur. R. XIV, p. 840.

Ronning Quartz Prospect. Owner, Southern Pacific Company. Lessee with option, P. R. Kelsey et al. In Sec. 19, T. 40 N., R. 7 W., five miles east of Callahan and 21 miles from Gazelle. In October, 1925, a crosscut had reached a length of 100 feet and it was expected would have to be run 90 feet farther before cutting a vein which prospected well on the surface. A Huntington mill, a 5-stamp mill from the Chapman prospect and a rod mill have been taken to the property.

Schroeder Mine. It is in Secs.. 17 and 18, T. 45 N., R. 8 W., 7 miles west of Yreka. It was extensively developed by adits 30 years ago and ore was milled in a 10-stamp steam power mill. It contains 5 patented claims, most of the work having been done on the Rosalie vein. Some prospecting work was being done in 1925, with a small crew.

Bibl: Cal. State Min. Bur. R. XIII, pp. 424, 425.

Scioc Mine. Owners, S. F. Bentley et al., Fort Jones. It is Min. Surv. 4016 in Sec. 13, T. 43 N., R. 10 W. in Quartz Valley district. A vein 1 to 2 feet wide has been prospected by a shaft 68 feet deep with 68 feet of drifting. There is a 2-stamp mill (1250-lb. stamps), a rock breaker, two gasoline engines, ore cars, tank and pipe. Water is scarce and ore has to be hauled 200 yards to mill. Reported to show good ore in face. One man employed in 1925.

Siskiyou Gold Mines Co., R. M. Snyder, president and Mrs. Anna Davis, secretary, 2045 East 70th street, Chicago, Ill. The holdings comprise 4 claims, three of which were bought from E. W. Morgan. They are on Horse Creek 8 miles above the mouth. The development work consists of a crosscut reported to be 335 feet long, 12 feet of drifting on one vein and 40 feet on another. Equipment consists of a 10-stamp Straub mill, a tractor, two old trucks and a pump to raise water from the creek.

Slim Jim Quartz Mine. Owner, G. G. Skillen, Sawyers Bar. One claim on west fork of Whites Gulch, two miles by trail upstream from the mouth, and five miles east of Sawyers Bar. A vein varying in width from two inches to two feet, averaging one foot, and striking nearly north between quartzite and schist walls, was worked through a tunnel 200 feet long and a raise to surface giving 80 feet of backs. Ore to the amount of about 100 tons was reported by the owner to have averaged $20 a ton. It was worked in an arrastra with a capacity of one ton in 24 hours, which was operated by a water wheel 23 feet in diameter. Cost of mining and milling was $5 a ton or more. No ore has been crushed for several years.

Snowflake (formerly *Bear Den*) and *Little Gem Quartz Claims.* Owner, James Cavanaugh, Rollin P. O. The claims are on Eddys Gulch adjoining the Boss Mine, 4½ miles from Sawyers Bar. The Snowflake claim has been worked in succession by Stent, Behnke and Cavanaugh, and has produced $8,000 or more, the last work by the latter having yielded a few tons of ore paying $23 a ton in free gold in an arrastra. The vein ranges up to 2½ feet wide and strikes north. The Little Gem is a fractional claim 400 feet long on which little work has been done.

Uncle Sam Consolidated Quartz Mine. Owner, Sheffield Estate, address Ed. Sheffield, Greenview. Sixty acres, patented, on divide between headwaters of Counts Gulch and Whites Gulch, elevation 5000 feet, and seven miles by road and trail from Sawyers Bar. This was one of the older quartz mines, located in 1873 and for many years a satisfactory producer, though idle in recent years.

The mine was opened by a series of crosscut adits from 120 feet to 550 feet long, with drifts on the vein for a maximum length of 420 feet. The vein strikes N. 20° E. and dips 45° to 60° SE., and is reported to have averaged 3½ feet in width between 'porphyry' hanging wall and 'slate' footwall. Early reports state the ore yielded $18 to $20 a ton in free gold down to the 500-foot level (364 feet deep), where the percentage of sulphides was three per cent to five per cent. Ore was crushed in an 8-stamp mill, operated by water power only during a short season in spring, due to small supply of water at this elevation.

Union Mine (formerly *Central* or *Evening Star*). Owner, Rollin Mining Company. Address Ben Daggett, or Leslie Daggett, Black Bear. Comprises two quartz locations one mile south of Rollin and between Klamath and Mountain Laurel Mines, at an elevation of 3900 feet. Lease and option to purchase held by Albert Ford, 10 Clifton avenue, San Jose, and C. H. Walters, 465 Marshall street, San Jose.

This mine was a producer years ago, having a record of $79,000 production from 7000 tons of ore. The surface of claims is a steep slope facing north near the head of Eddys Gulch, and the claims are separated on the north from the Mountain Laurel and on the south from the Klamath Mine by gullies which probably mark the courses of faults. It seems nearly certain that all three mines are on segments of the same fissure, or closely parallel fissures.

The outcrop of the Central vein, striking nearly north, was worked for a length of 600 feet. Crosscut adits were run later, the principal one cutting the vein 160 feet from the portal on Union Claim. A drift south from here for 250 feet on vein is still accessible for 175 feet. It gave backs of 80 feet on the vein, which has been stoped out nearly to surface except for one block about 90 feet long. The vein here dips 18° to 24° E. and is two feet to six feet or more in width. The hanging wall is black slaty schist, containing considerable graphite, and frequently much twisted and broken. The footwall is a decomposed, light-colored dike rock, common in the mines of the district. On the south side above drift, the hanging wall portion of vein, which is two to three feet wide, and separated from footwall portion by gouge, has been stoped. There remains on footwall an equal or greater width of vein containing quartz and brecciated fragments of slate. The vein has also been underhand stoped for about 70 feet on strike and 40 feet on dip. In the north drift which is 70 feet long, the vein is broken and narrow at the face. The dip of vein on this side suddenly steepens and it was followed down 25 feet or more by a winze, now full of water but said to show 11 inches of good ore.

Southward beyond the stoped ground a drift said to be 1100 feet long was run in search of the northward extension of the Klamath ore shoot, but this was not found. This is in the Union Extension claim. Near the north end line of Union claim a winze 20 feet long shows a vein 1½ feet wide composed of quartz and 'slate' ribbon rock. Near this end also a crosscut was run 500 feet east but failed to develop ore.

It appears from observations of the steep topography, and the underground geologic conditions, that the developed portions of this and nearby veins in the same formation may be sections which have been bent over nearly flat and perhaps broken away from the remaining deeper sections of veins that were originally much steeper in dip. Movement of the mountain mass in a northwesterly direction due to gravity, would account for such a result, and the heavy gouges in the several mines would indicate that such movement is continuing.

At one time, 40 years ago, there was a 4-stamp mill on the property but there is no equipment now. The ore in sight is low grade.

Vesa Creek Pocket Mine. Owners, Harry, Joseph and E. Davidson. This is on Vesa Creek, a tributary of the Klamath, 12 miles from Yreka. The owners have produced several thousand dollars from it in recent years.

Victoria Quartz Prospect. Owner, L. H. Brown, Dunsmuir. This contains 40 acres in Sec. 6, T. 39 N., R. 3 W., 1½ miles east of Mott. There are said to be thirteen veins on the claims, carrying gold, silver and copper. Several hundred feet of prospecting and development work has been done.

Bibl: Cal. State Min. Bur. R. XVII, p. 535.

Victory Gold Mines Company. A. M. Buley, president. Office 1104 Pacific Mutual Building, Los Angeles. John Nefroney, general manager. The company claims 11 unpatented quartz locations in sections 16, 17 and 20, T. 40 N., R. 10 W., and also owns the Advance Mine (which see, *ante*), adjacent to South Fork of Russian Creek three miles by road from Finley Camp and 22 miles from Etna Mills by road. The property extends from South Fork of Russian Creek, elevation 3400 feet to top of ridge between the two forks, nearly 2000 feet higher. Gazelle, the nearest railroad point, is 52 miles east.

Geological conditions are similar on these claims as far as opened, to those noted under Advance and Hardscrabble properties. Several belts of black schist, up to 50 feet wide, striking north to N. 20° E. and dipping steeply to the west, cross the property. Three of these noted by the writer carry quartz stringers and narrow veins running mostly parallel to the strike of the schist, and other such belts are reported on the property, but were not visited on account of lack of time. This series of schist belts has been opened at intervals on the Victory, Hardscrabble and Advance claims for nearly a mile along the strike, showing in place on all three properties with a practically identical strike and dip. The numerous dikes interbedded with the schist are prominent and are usually to be seen in the workings on the hanging wall side of those sections stated to carry the best ore. Some of these dikes carry noticeable amounts of pyrite. The black schist is probably derived from an older series of intrusive rock of basic character, with associated beds of limestone, and due to its structural weakness became the locus for shearing movements and for the deposition of quartz, calcite and gold of the ore after or contemporaneous with the injection of the later dikes, which are of several generations. This older schist series has been considered by some writers [1] to be a series of metamorphosed sediments of Algonkian age; Professor J. P. Smith has grouped them all as "pre-Cambrian metamorphics" believing them to be partly igneous in origin. In this particular locality, they are notably high in hornblende, occasionally show some graphite, and considerable calcite is in evidence.

Most of the work has been on the Bluebird ledge. Tunnel No. 1 is 250 feet long, 150 feet below the apex, and Tunnel No. 3 is 220 feet long with short crosscuts, and is 400 feet below No. 1. Two other short tunnels and several short open cuts have been opened along the strike, all this work being on the north side of South Russian Creek. A great number of assays are on file in the company's records showing high values, but as far as could be learned the method of sampling and assaying has not been such as to show average values of the widths of ore claimed, which range from three feet to 40 feet. A portable gasoline driven air compressor has been installed at No. 3 adit as the rock in depth becomes hard.

On Sourdough claim, east of above, work was done years ago and a few tons of ore packed to the Lanky Bob mill in Whites Gulch is said to have paid $37 a ton. There are adits 175 and 160 feet and a shaft 55 feet deep, said to show a vein four feet wide, also a crosscut 300 feet long and considerable drifting on the vein. On the Peerless claim two crosscuts, 92 feet and 110 feet long, running toward the Bluebird ledge have not yet reached it. On Lena and Pauline claims assessment work only has been done. On the Humming Bird over 200 feet of work, including a shaft 79 feet deep, and a crosscut 120 feet long, is stated to have been done. Crosscuts have been started on Hardscrabble Extension No. 1 and No. 2 claims. On Marietta claim, on the Queen vein near the office, a black schist belt 50 feet wide has the usual dip and strike, carries quartz stringers and pans free gold at the surface, but no work has been done on it.

The widespread distribution of gold on these three adjoining groups of claims makes the area an interesting one, and it is to be regretted that no system of sampling and assaying has been adopted to show the operators the tonnage and value claimed to be in sight, although probably hundreds of random assays have been made. No work was being done on this property October 29th, but an early renewal of operations was planned.

The property is equipped with a bunkhouse of 20 rooms, boarding house, garage, machine shop, carpenter shop, office and smaller buildings, all new and well made. A new electric power line 15¾ miles long from Etna Mills has recently been completed to the property, also 1½ miles of secondary line. A second-hand 30-stamp mill has been brought to the claims, but not yet erected, as no building has been provided for it. There are also in storage on the property an electric locomotive, 30 ore cars, electric hoist, 40 electric motors ranging from 4 to 125 h.p. and a great quantity of other equipment and supplies. A Sullivan compressor, capacity 680 cu. ft. per min., has been installed, with 125-h.p. motor, and another of 460 cu. ft. per min. capacity is in storage, and company has three trucks of 3½, 2½ and 1 ton capacity.

---

[1] Hershey, O. H., Am. Geologist, Vol. 27, No. 4, pp. 225–245.

Water rights are claimed on South Russian Creek and Musick Creek.

Wanda Group. Owner, O. L. Palmer, Forks of Salmon. Comprises three claims on Grahams Gulch, tributary of South Fork of Salmon River, about seven miles southeast of Forks of Salmon, by trail.

A quartz vein from a few inches to six feet wide has been prospected by an adit and two shallow shafts, showing an average of four feet of quartz. In the fall of 1925 Palmer was reported to have about 100 tons of ore out ready for crushing and twice as much in sight. He contemplated the building of an arrastra. Water is available from Indian Creek or the river.

Wilson Brothers Prospect. Owners, Wilson Bros., Sawyers Bar. There are two quartz locations on the west side of Eddys Gulch, near Rollin P. O., at an elevation of 3400 to 3500 feet, and 3½ miles by road south of Sawyers Bar.

Several short adits have been run to develop a quartz vein similar geologically to those in the Ida May, Central and other mines nearby. The lowest adit is about 150 feet long, of which 36 feet of drift follows a vein from a few inches to three feet wide, in black slaty schist and on the contact of schist and a light colored dike. The vein strikes N. 70° E. here and dips south. Forty feet higher, a second adit was run about 170 feet, and about 36 feet is on the vein, which strikes nearly due east and dips 65° south. In the upper adit, which is 25 feet above the second, and is on the vein for 100 feet, the vein is enclosed between a heavy, broken lens of schist on the hanging wall and dike or 'cab' on the footwall.

The property is equipped with a 2-foot Chili mill and 6-inch rock-breaker, operated by 3-h.p. gasoline engine. A total of 130 tons of ore is reported to have yielded the owners $2,000.

Wood Gold Prospect. Owners, Sam K., Stanley and Mrs. J. C. Wood, Mrs. Lena Hibbard and E. L. Brier, of Seiad P. O. This is a group of six quartz claims on Thompson Creek, ten miles by trail from the mouth. Thompson Creek enters the Klamath River 65 miles from Hornbrook by road. The claims were not visited, but samples shown carry pyrite, galena and free gold. A prospect adit had reached a depth of about 100 feet late in 1925. The vein is reported to be eighteen inches to two feet wide. There is no equipment on the claims.

Gold Mines (Placer).

Since the passage of anti-debris legislation, and the decision of Judge Sawyer which put a stop to hydraulic mining in the Sierra Nevada Mountains in 1880, Siskiyou County, whose rivers are nonnavigable in their entire lengths, and drain little arable land, has shared with Trinity County the distinction of being the scene of all varieties of placer mining. Besides the advantage of being able to dump debris into the rivers unhindered, the placer miners of this county generally are able to get a good water supply, and have little trouble from rival claimants, such as power companies and irrigation and municipal water districts, which in the central part of the state have nearly completed the appropriation of available water in the mountains. Since the world war increased operating costs, and also due to a succession of dry years, placer mining even in this favored region has not flourished as it did formerly. Of course this is due partly to the exhaustion of much good ground, but it is a fact that there remain in the county several thousand acres of placer mining ground.

The Klamath and Salmon rivers have been and continue to be the principal placer mining districts. The geology of their bench deposits has been covered elsewhere herein. It is worth noticing that the richest districts have been in sections where gold can be traced to a nearby local source. The Hamburg Bar Diggings, below the mouth of Scott River, which was enriched from Scott Bar downstream by a seam belt; and the North Fork of Salmon River westward from the mouth of Eddys Gulch, which dumped into the river millions in gold from the quartz veins which were eroded into its upper branches, are striking examples of this. Local bedrock conditions, where wide belts of soft rock cross the river and are followed by hard reefs, have promoted the meandering tendency of the stream, aiding the formation of a series of bars, benches and back channels. The latter condition may be present without the former, resulting in accumulation of considerable low grade gravel, or spotty values, as in some sections between Hamburg and Happy Camp. A third set of conditions, where the river takes a course parallel to the general direction of schistosity of the country rock, results in the erosion of a steep, rocky canyon, with bench and bar deposits small or lacking. This latter condition exists downstream from Happy Camp to Orleans.

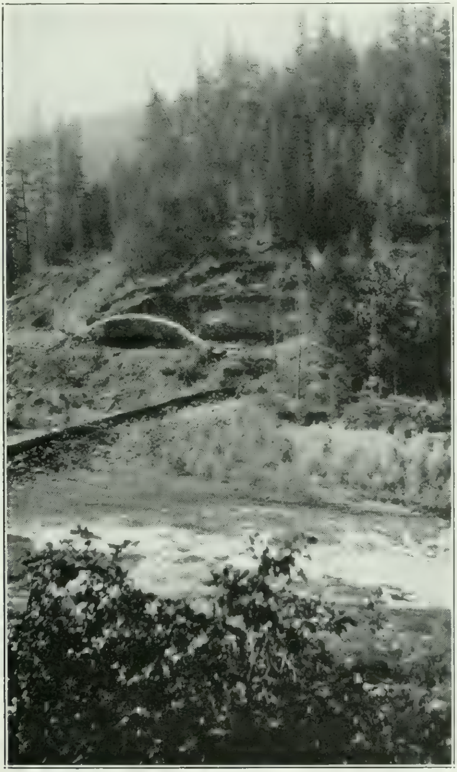
Gravel mining along the Klamath River has been quiet of late, but there is considerable new material to record herein regarding properties not previously covered in the Bureau's reports. More activity is to be noted on the Salmon, where a number of properties are working by the hydraulic process. Scott Bar and vicinity give promise of some work besides the Quartz Hill operations, where a pocket mine in the seam belt is being hydraulicked. The districts of Beaver Creek, Little Humbug, Callahan and Quartz Valley show small scale operation when water is available.

Abel W. Cook Placer Mine (Big Nugget P. M.). Owner, Abel W. Cook, Oak Bar. This comprises four placer claims of 20 acres each on Horse Creek, including its bed and bars for one mile in length, beginning five miles by road above the mouth. It is 42½ miles by road from Hornbrook, and at an elevation of 1950 feet.

The deposit is loose stream gravel nine feet deep on the upper end of mine and 70 to 80 feet wide. The creek is said to have remained unworked on account of the lack of grade and dump. Most of the pay is in the lower part of gravel in the stream channel, but all carries some gold and some nuggets up to $18 each have been found. Cook has been on the property three years and has stripped the top gravel preparatory to mining with a self shooter to bedrock. The top gravel is said to have paid 60 cents a yard. Water is taken from the creek a short distance above the claims. The only equipment is sluice boxes and hand tools.

Anderson Placer (see *Joubert Placer Mines*).

Abe Lincoln Placer Mine is on the south side of Klamath River nearly opposite the Portuguese Mine and has been worked a little by the same company. It is a gravel covered bench having a length of about 900 feet along the river and a width of 150 feet. The gravel is ten feet deep, with as much as 60 feet of overburden. The front rim is said to have paid when piped off some years ago for a width of 50 feet, but one-half acre piped by the present company yielded only about $1,000. They have also drifted for 400 feet along bedrock, finding a very narrow, thin paystreak. Bedrock is 25 feet above the present river. The small hydraulic outfit uses water from Portuguese Creek.



Abe Lincoln gravel prospect on Klamath River, near Seiad Valley.

Ballingal Placer. Owner, R. F. Ballingal, Callahan. Includes several placer claims, unpatented, at the junction of Jackson Creek with the South Fork of Scott River, six miles south of Callahan, 4½ miles of the distance being over a good road and the balance trail. Elevation is 4000 feet or more. The gravel lies between the two streams and may have been deposited by either of them when at a higher level. The bank is of moderate depth without overburden and there is a fairly good dump. There are some large boulders, characteristic of this section of the river, where the size of the wash is out of all proportion to the present size of the streams. A derrick would be required to handle these boulders. The gravel is free wash and has been ground sluiced in a small way by the owner, who has realized a small yearly return in coarse gold but has been able to handle only a very little gravel. Water is available under good head for hydraulicking and there are several acres that could be worked in the one piece, with other similar areas on the claims. Besides ground sluicing, Ballingal has done considerable prospecting underground with drifts. Parts of this ground were drifted in the earlier days when Callahan was a thriving placer mining camp.

Bibl: Cal. State Min. Bur. R. XX, p. 180.

Bark House Creek Placer. In Oak Bar district. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 844.

Beaudry Placer Mine. In Secs. 3, 11, 34, 35, 30, 26, 2 and 23, T. 39 and 40 N., R. 8 and 9 W., in Callahan district on and adjacent to South Fork of Scott River, one mile southeast of Callahan. Owner, Madam Angele Bazet, 4 Laguna Street, San Francisco.

This is the largest mining property in the district, containing 640 acres of patented land and controlling sufficient water from the river and nearby tributaries for large scale hydraulic mining. No mining has been done since the war. The property contains several old claims, worked in whole or in part many years ago by the predecessors of the present owner, and also a considerable area of unworked ground. The bedrock is schist and the gravel 20 to 60 feet deep, and values are spotted. Ditches 15 miles and two miles in length respectively, from South Fork of Scott River and Wildcat Creek have been kept in fair shape during the last period of idleness. There are several thousand feet of iron pipe and other hydraulic equipment and several buildings on the property.

Bibl: Cal. State Min. Bur. R. XIV, p. 844; Bull. 92, p. 99.

Belle Josephine (Slide Creek). Owner A. E. Westover, Callahan. Contains 160 acres on Slide Creek, six miles southwest of Callahan in Sec. 14, T. 39 N., R. 9 W. Is partly virgin ground and partly old claims worked years ago. Leased with option in 1925.

Bibl: Cal. State Min. Bur. R. XIV, p. 844.

Big Bend. Owners, H. J. Barton, James Allen et al., Yreka. Comprises 120 acres on Klamath River two miles west of Oak Bar.

This is thought to be a section of old channel covered by a slide. A tunnel was being run in the summer of 1925 to prospect it. Part of the ground was worked by J. Ross Wade several years ago.

Big Slide. In Sec. 19, T. 46 N., R. 8 W.

Bibl: Cal. State Min. Bur. R. XIV, p. 859.

Blaylock & Schon Placer is on a low bar of Klamath River just above Oak Bar on property belonging to Mrs. Mott. Two men have been working during the past season. An incline has been sunk into the old back channel and some production was said to have been made during the season.

Bloomer Mine. In Secs. 33, 34, T. 11 N., R. 7 E., six miles northwest of Forks of Salmon, and contains 51 acres. Owner, Bennett Company. George Wm. Smith, manager, Forks of Salmon.

The deposit consists of from 20 feet to 40 feet of gravel in an old channel covered by 40 feet of clay and slide material, and lying about 200 feet above the present river. It has been partly worked out but has been idle for several years. A supply of 1000 inches of water was obtained from Nordheimer Creek for four months yearly, and the early operations, which were on a small scale, paid well as the ground was easy to work and averaged well in gold.

Bibl: Cal. State Min. Bur. R. XI, p. 426; XII, p. 278; XIII, p. 390; XIV, p. 844.

Blue Gravel (Black Lead). In Sec. 32, T. 45 N., R. 7 W., two miles south of Yreka.

Bibl: Cal. State Min. Bur. R. XIV, p. 844.

Blue Hill. In Sec. 16, T 45 N., R. 10 W., one-half mile south of Scott Bar. One 20 acre claim, idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 845.

Blue Nose Mine. Owner, Blue Nose Mines Company, Blue Nose P. O. Comprises five unpatented claims in Sec. 5, T. 13 N., R. 6 E., H. M., on Klamath River 18 miles north of Somes Bar.

The deposit includes four benches of Klamath River about 60 feet apart. The gravel is loose, medium sized and about 20 feet deep with an overburden of 40 feet of country rock slide material, largely serpentine. The claims were located first 33 years ago. Norman Carter sold to Donald McPherson and the latter after doing a very little work sold to the company. Water from Carter Creek through three-fourths mile of ditch and flume, giving 430 feet pressure and a six months run, was used, and in 1919 the company applied for 45 cubic feet per second of the water of T-Bar Creek. This requires a dam and three miles of ditch. Operations have been on a small scale using two No. 3 Giants and 600 feet of sluice.

Boulder Creek Placer (Fippen & Hayden Mine). Owners, Fippen & Hayden, Callahan. It contains 60 acres, unpatented, three miles by road and trail south of Callahan on Boulder Creek.

A decomposed dike along the contact of serpentine and granite carries seams and veins of quartz. Some rough gold, occasionally coarse, has been recovered from hydraulic mining operations in two small pits opened on the dike, the total area worked being perhaps two acres. The total production has been small.

The property is equipped with 150 feet of 8-inch and 11-inch pipe and one small giant. Water controlled by the McKeen Mine is bought for $1 a year. The mine has two ditches, of which the lower, about two miles long, has been used recently and the upper has been allowed to go to ruin. The bank is getting high and the upper ditch will have to be put in use if much more piping is to be done.

As mentioned elsewhere, there is also a prospect of lead on these claims.

Bibl: Cal. State Min. Bur. R. XX, p. 180.

Boulder Point. Owner, Joseph Weeks, Scott Bar. Little or no work recently on account of lack of water.

Bowersox Mine. Owner, W. P. Bowersox, Somes Bar. In Sec. 2, T. 11 N., R. 7 E., H. M., at Somes Bar. Contains 40 acres partly worked out, with 20 feet of gravel. It has been worked on only a limited scale in late years.

Bibl: Cal. State Min. Bur. R. XIV, p. 845.

Brazil. An old placer, 80 acres, in Hawkinsville district, Sec. 11, T. 45 N., R. 7 W. Ground sluicing and drift mining was done for many years. Gravel was 14′ deep.

Bibl: Cal. State Min. Bur. R. VIII, p. 612; XIII, p. 391; XIV, p. 859.

Brown & George Mine. Address T. H. George, Cecilville. Hydraulic property in East Fork district.

Bibl: Cal. State Min. Bur. R. XII, p. 391; XIV, p. 845.

Burns Placer Mine (see *Joubert Placer Mines*).

Campbell Placer. Owner, H. A. Weed et al. Mineral Lots 42, 48, 29, 46 etc. in T. 43 N., R. 10 W., 394 acres; mineral rights to Lots 5, 6 and 7, in Sec. 11, T. 43 N., R. 10 W., containing 47 acres, and Mineral Lot 45, 81 acres in Sec. 13, T. 43 N., R. 10 W.

This is in Quartz Valley district and contains a large part of the placer ground there. It has not been operated since 1910.

Bibl: Cal. State Min. Bur. R. XII, p. 279; R. XIII, p. 392; R. XIV, p. 845.

Carpenter and Robertson. Owners, S. Carpenter and E. M. Robertson, Cecilville. Prospect in gravel at junction of East Fork and South Fork of Salmon River, near Cecilville.

Cecilville (Sightman) Placer Mine. Comprises 40 acres on Crawford Creek, near Cecilville. A small producer which was operated by G. H. Sightman for many years, using one giant and water from Crawford Creek.

Bibl: Cal. State Min. Bur. R. XIV, p. 845.

Classic Hill. In Sec. 36, T. 18 N., R. 6 E., H. M. This mine contains about 70 acres, patented, and 12 unpatented placer locations are claimed. It is on Indian Creek 11 miles by road north of Happy Camp. In proportion to yardage handled, it was perhaps the best paying mine in the district, but has been idle many years.

The deposit mined by hydraulicking is the upper oxidized and decomposed portion of a series of dikes carrying auriferous quartz seams and limestone in serpentine. This series is one-half mile or more wide traversing a well-defined saddle about N. 20° E. with serpentine on the east and basic dikes and mica schist on the west. When the bank became high in the later years of mining, operations were hindered by the serpentine swelling and rising in the cuts faster than it could be piped away so that little progress could be made. There is still considerable ground unmined.

The ditches are in poor shape. One six miles long giving enough water for one large giant under 140 feet head, needs a number of flumes. Another nine miles long lacks two miles of being finished. Both of them head in the West Fork of Indian Creek and would give ample water. There is little equipment and one building on the claims.

Conzetti Placer Mine. On upper South Fork of Salmon River, Cecilville district. Leased in part in 1922 to Lewis Roff, Almon Strickling, and Archie Farnsworth, who did some hydraulicking. Later reported leased to Thos. Meloney and Grant Bates. G. A. Conzetti, Cecilville, owner.

Crapo Placer Mine. Owner, Bennett Company. George Wm. Smith, manager, Forks of Salmon. Contains 39 acres, patented. In Sec. 11, T. 10 N., R. 7 E., three miles northwest of Forks of Salmon, on a high bench about 400 feet above Salmon River. Formerly worked with a supply of 1500 inches of water from Crapo Creek, and was a good producer but has been idle for many years. The gravel was 20 to 25 feet deep, with 20 feet to 60 feet of clayey overburden. Includes the Fort Beyers claim.

Bibl: Cal. State Min. Bur. R. XI, p. 427; XIII, p. 396; XIV, p. 846.

Croesus Placer Mine (*Hickey*). John Teukert, owner, Sawyers Bar. Contains 20 acres, an upper bench gravel claim on North Fork of Salmon River, 6½ miles west of Sawyers Bar. The gravel is covered with a heavy overburden and carries large granite boulders. Teukert operates it as an hydraulic mine, using water from nearby gulches, and the season is short.

Cronin Placer Mine (see *Gallia Placer Mine*).

Davis Consolidated Mines. Owner, Estate of Reeves Davis, deceased. Address W. F. Davis, Executor, 427 J street, Sacramento. The property contains 634 acres of patented ground and 265 acres of unpatented placer claims in Secs. 2, 11, 10, 15, 16, 21 and 22, T. 16 N., R. 7 E., H. M. The holdings extend along the Klamath River nearly three miles, including part of the town of Happy Camp, and placer mining ground on both banks of the river at the confluence of Indian Creek. Hornbrook, the nearest railroad point, is 76 miles easterly.

Mining began on the river frontage of this property in 1852, when there were many separate owners of claims, which were consolidated in

1899 by Rutgers Van Brunt under the title of Oregon Gold Mining and Water Power Company. Among the early operators were Raymond and Ely, who are stated to have produced $40,000 in four seasons from Schoolhouse Flat, east of the river; and Ah Ock, who is said to have produced $100,000 from the ranch portion of property, a mile and a half downstream from Happy Camp on the west side of the river. In three seasons, 1899–1902, the Van Brunt interests worked possibly 12½ acres by hydraulicking, and produced about $70,000. The property was sold to Davis in 1908. During his operations he produced $72,091 from 11.5 acres, according to his own records, quoted in his report on the property, from which the above is summarized. Davis' last work was done in 1919.

The gravel deposits upon this property consist of a series of three benches, representing former levels of the Pleistocene and Quaternary Klamath River having nearly the same gradient and course as the present stream. The bedrock is soft slaty schist and the three benches of gravel are 10 feet, 80 feet and 165 feet above the present river. The grade of the old channels is 15 feet per mile, three feet more than in the present stream. The gravel is tight, containing some boulders up to one-half ton in weight, and in places has been found cemented to the bedrock in small patches. The uppermost bench contains 30 feet of gravel, of which the lower six feet carry about one-half of the pay; above this is a layer of sandy clay and fine gravel, two feet to 40 feet deep, and this is covered by red clay soil sometimes up to 40 feet thick. The deposit on the second bench contains about 20 feet of gravel covered by 20 feet of sandy clay, and the first bench deposit is 20 feet deep. Remnants of the first bench occur at the southwest end, and part of the second bench at the northeast end. Davis' work was all done on the third bench, on west side.

Davis stated that the best pay and coarsest gold from the third bench was found in a series of gutters or sub-channels, which had been cut six feet to ten feet deeper than the rest of the bedrock on the bench. He found 12 of these gutters, all parallel.

Two remaining sections of gravel, parts of the first and third benches, are occupied by the ranch property, one of the finest of the kind in the county. The third bench here is fully one-fourth mile wide, and one-half of the ranch area containing 60 acres of it has been prospected by drilling, the record of this indicating a gold content of $5,290 per acre. There is claimed to be a total of 500 acres of unmined gravel on the property.

Running adits across the channel on the bedrock or as near it as possible was found to be the most reliable way of prospecting. Preparatory to mining, all brush and timber was cleared off of several acres each season. When possible it was also desirable to pipe off in advance the red clay soil overburden. The gravel bank was undercut with the giant, caved and driven into the headrace and thence into the sluices. Four tons of dynamite for a season's run of eight acres were used to break up boulders. Sluice boxes were three feet wide and three feet deep, set on a six inch grade and paved with round pine blocks 11 inches thick. Only 300 feet of sluices were used, and there was no undercurrent, so there was probably considerable loss of fine gold. As the outer rim of the old channel is preserved, it was necessary to run sluice tunnels or cuts from the river bank above the level of high water, through the rim up to the gravel bank on a grade of six inches in 12 feet. Such tunnels, to make available remaining ground, would have to be 1000 feet to 2000 feet long.

This property has the first right to water out of South Fork of Indian Creek, a large tributary of Klamath River entering from the north. Sixteen miles of ditch and flume with a capacity of nearly 3000 miner's inches gives a head of 206 feet on the third bench. The dam, ditch and flume have been neglected for several years, and a large sum would be needed to rehabilitate them. If this supply were fully available, a maximum season of eight months would be possible in favorable years. The waters of Doolittle Creek can also be turned into this ditch four miles from the mine. A ditch two miles in length from Griders Creek was originally built to carry 1000 inches, but is also in bad shape.

The property is equipped with a sawmill, ranch buildings, and a large old hotel and other buildings in the town of Happy Camp. There is a good stand of timber on the claims. Mining equipment includes 3000 feet of large diameter pipe and two siphons (on ditch line), and 3000 feet of pipe from 15 inches in diameter down, at the mine.

Dick Morris Placer (Joe Ramus Placer). Owners, J. B. Nowdesha and Mrs. S. D. Johnson, Hamburg Bar. Contains 59 acres, unpatented, in Sec. 35, T. 46 N., R. 11 W., 1½ miles west of Hamburg Bar on the south side of Klamath River.

This is a high bench from which perhaps five acres have been hydraulicked. The overburden is increasing rapidly to the southward. Most of the pay is in the lower part of the bank. Water for operating is scarce as the property has only a second right to water used by the adjoining Hammer Mine. One giant is used when water is plentiful. The present owners may drift on the bedrock if no water is available this winter.

Bibl: Cal. State Min. Bur. R. XIV, p. 848.

Doggett Mine. Near Oak Bar, on Klamath River. Worked out by A. C. Aiken and sold as a ranch in 1916.

Dunnigan Placer. In T-Bar Creek district, 36 miles south of Happy Camp. Deposit similar to Blue Nose property.

Bibl: Cal. State Min. Bur. R. XIV, p. 848.

Eastlick Mine. Owner, Reichman Mercantile Company, Fort Jones. In Secs. 7 and 8, T. 43 N., R. 9 W., in Oro Fino district. It was formerly a good producer but has been idle for many years.

Bibl: Cal. State Min. Bur. R. VIII, p. 608; XIII, p. 398; XIV, p. 848.

Elliott Placer Mine (Golden Nugget). Contains 20 acres on Jackass Gulch a mile and a half from Sawyers Bar. The gravel bank was 15 feet to 40 feet high and was worked years ago by the hydraulic process, but the property has been idle in recent years as most of the ground has been worked off and there is no equipment.

Bibl: Cal. State Min. Bur. R. XIV, p. 848.

Fir Tree Placer Mine. Owner, Bennett Company of Forks of Salmon. One 20-acre hydraulic claim on Salmon River one mile west of Forks of Salmon. This property has been idle a great many years. The company is planning resumption of mining the present season on some of its claims in this vicinity, and at the forks.

Forks Placer Mine (McNeals Bar). Owner, Bennett Company of Forks of Salmon. George Wm. Smith, manager. Comprises 50.78 acres at and near Forks of Salmon. Mining has been done on the south side of main river adjacent to McNeals Creek and south of the confluence of the two forks of the river. Perhaps three or four acres have been hydraulicked opposite the town, across the river, the last work having been done by Forks of Salmon Placer Mining Company in 1923–24.

Forks of Salmon River Hydraulic Mine, at Forks of Salmon, Siskiyou County.

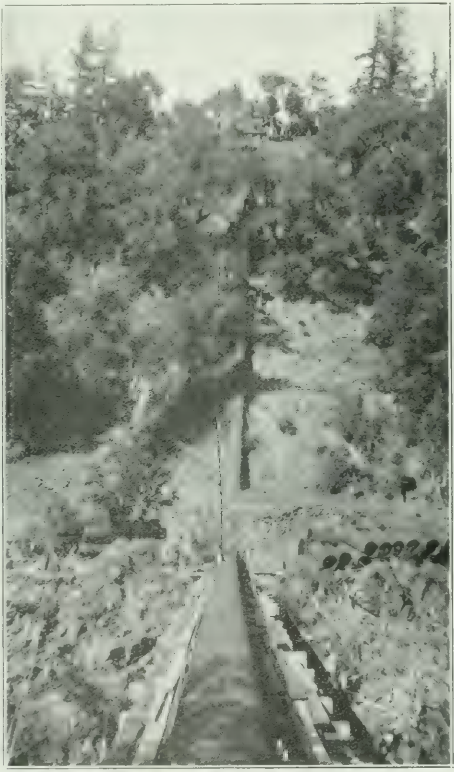
The gravel is 30 feet to 40 feet deep, mostly fine to medium size, free wash, with few large boulders, with only one or two feet of soil overburden. It lies on the first bench above the stream and has about ten feet dump directly into the river, which in this district is relied upon to clear itself several times each season in storm periods. The bedrock is schist and limestone.

Six miles of flume formerly used to bring water from the North Fork to Bonaly Mine was being repaired (Oct. 1925) to bring water upon this and other mines of the Bennett Company, who plan to work here and a mile farther down the river the coming season. The old company's water supply was 3800 inches with a season of ten months.

Bibl: Cal. State Min. Bur. R. XII, p. 287; XIII, p. 401; XIV, p. 849.

Frazier Placer Mine (see *Woodfill and Barry Mine*).

Gallia Placer Mine (formerly *Paddy Cronin Mine*). Owner, A. Jacquemart, 320 Market Street, San Francisco. E. Jacquemart, superintendent, Sawyers Bar. Property contains 120 acres, with a frontage of one-half mile and width of 750 feet along the north bank of North Fork of Salmon River, and a 20-acre bench claim on south side, 4.6 miles by road west of Sawyers Bar. Elevation 1900 feet.

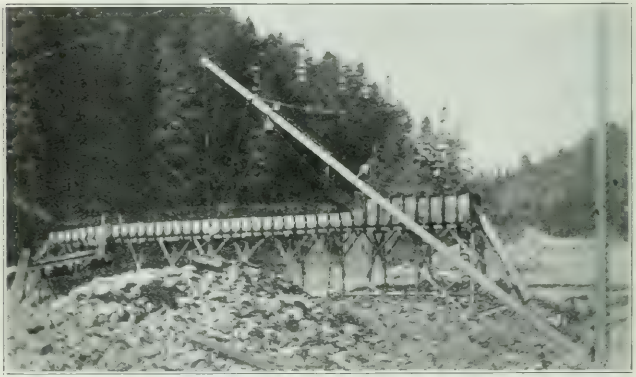


Pipe line, Forks of Salmon River Hydraulic Mine.

The deposit on north side is a back channel of the North Fork, little, if any, higher than the present stream. It is covered by 15 feet of barren granite sand and contains some large boulders of granite brought in from the north side, as well as the river wash. The depth of gravel is 20 feet.

The mine was worked in a small way only in the past because of lack of water. An ample water supply formerly used at the adjacent Red Hill Mine was acquired in 1924. Four thousand inches under 315 feet head is claimed to be available for as long as nine months in favorable years. The supply comes from Little North Fork of Salmon River, through four miles of flume and 6200 feet of iron pipe, including one-fourth mile of main pipe line, from 24 inches to 48 inches in diameter.

The ground is worked by hydraulic process, using two bank giants, a Hendy hydraulic elevator and a dump giant to clear tailings from in front of the sluices. The elevator has a vertical lift of 34 feet and the elevator giant uses 1000 inches of water. The capacity is 250 cubic yards a day. Elevator discharges into a flume 3′ by 5′ in cross section and 120 feet long, with improved riffles and undercurrent. A Pelton wheel operates a derrick for hoisting boulders from the sump. The sluice dumps into the river, which disposes of accumulated tailings in periods of high water. Five or six men are employed and it is hoped that when in full operation the ground can be worked for 15 cents a cubic yard. E. Jacquemart reports that in 1924–25, when operations did not reach full time on account of various delays and adjustments incidental to new work, 20,000 cubic yards were mined which paid one dollar a yard.



Elevator, flume and derrick, Jacquemart Hydraulic Mine, on Salmon River.
Photo by courtesy of Jacquemart & Son.

The property is well equipped with several new dwellings, shop buildings, garage and electric lighting plant.

Gearhart Placer. Owner, H. J. Barton, Yreka. Contains 120 acres, along Horse Creek for a length of one mile, beginning four miles above the mouth of the creek, at an elevation of 1850 feet. Hornbrook is 41 miles distant.

This deposit is similar to the Abel W. Cook Mine (which see) and is nearby and downstream from it. It has been worked irregularly in a small way for many years. Lately the ditch 3½ miles long has been allowed to go to ruin.

Geeshan and Kellner Placer Mine. Owners dead, property idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 850.

Gibson Bar Drift Mine. Owners, Joe Davidson and J. J. Skehan, Gottville. A 20-acre placer claim, unpatented, in SE¼ of Sec. 6, T. 46 N., R. 7 W., two miles east of Gottville on an old bar of Klamath River.

Hydraulic elevator at Jacquemart Hydraulic Mine, five miles west of Sawyers Bar, on Salmon River, Siskiyou County, showing method of installing elevator, supply pipe, etc. The elevator section is 20 feet long, and suction joint, etc., 9 feet. Photo by courtesy of Jacquemart & Son.

The owners were sinking an incline, going down on the bedrock and had reached a depth of 60 feet on the slope or 36 feet vertical late in October, 1925. A 4-h.p. gas engine, No. 3 Hooker pump and small hoist were in use. The ground is supposed to be mostly virgin on bedrock.

Gold Bank Placer Mine (see *Woodfill and Barry Mine*).

Gold Hill Placer Mine. Owners, Bigelow Brothers, Sawyers Bar. Formerly a good producer, but about worked out and idle. Is adjacent to Sawyers Bar townsite, on a bench of North Fork of Salmon River.

Bibl: Cal. State Min. Bur. R. XIV, p. 850.

Gold Leaf Placer. Owner, Charles Dillstrom, Yreka. One placer location in Sec. 8, T. 45 N., R. 8 W., in Hawkinsville district.

The gravel has a maximum depth of 20 feet and is sluiced wth water from Long Gulch, but the water supply is limited, and little has been done by the present owner.

Golden Rule and Scott Bar Claims. Owners, Turner Brothers, Yreka. Two placer claims containing 40 acres on hillside on west side of Scott River at Scott Bar. This property is one of a number of so-called 'seam diggings,' on a belt crossing Scott River at this point. Part of the ground, reported to be about six acres, has been worked. Very little water is available. The Bilberry Lakes, about an acre in area, could be used for small scale work. There is one giant and 400 feet of 9-inch and 15-inch pipe on the claims. Idle.

Grider Mine. In Seiad district, on Klamath River nine miles west of Hamburg Bar in Secs. 10, 11 et al., T. 46 N., R. 12 W.

Formerly operated as a hydraulic mine, but has been idle many years and was recently sold to Garrett for ranch and resort purposes. It contains unworked bench deposits.

Hammer Placer. In Sec. 36, T. 45 N., R. 11 W., and adjoining, one-half mile west of Hamburg Bar. Owners, Johnson et al., Hamburg Bar. This is a bench gravel mine on south side of Klamath River. Has been worked irregularly in late years. Water is obtained from Kuntz and Mill Creeks through three miles of ditch, and there is hydraulic equipment and a dwelling.

Bibl: Cal. State Min. Bur. R. XIV, p. 851.

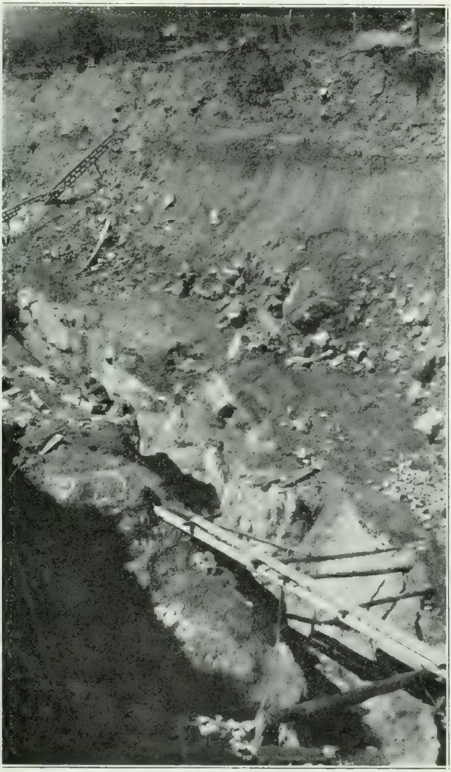
Hoosier Hill Placer (Willard Drift Mine). Owner, J. B. Nowdesha, Hamburg Bar. Twenty acres, in Sec. 36, T. 46 N., R. 11 W., one-half mile west of Hamburg Bar on south side of Klamath River. This is a high bench claim, mostly hydraulicked years ago and idle the past 10 years. There is no water right or outfit for hydraulicking now, but Nowdesha thinks some drifting ground remains. An adit is in 30 or 40 feet.

Imperial Heights Mine. Owner, Ed Hickey, Sawyers Bar. Contains 40 acres, on North Fork of Salmon River two miles west of Sawyers Bar. Deposit contains 20 to 80 feet of gravel and has been worked in a small way for many years by Hickey as a hydraulic mine, using water taken through a ditch from Shiltos Creek.

Bibl: Cal. State Min. Bur. R. XIV, p. 852; XII, p. 284.

Joubert Placer Mines (formerly *Peterson Mine* and includes Wm. Burns, Anderson, Late Discovery, David Casey, Upper Manuel, and Stevens placer claims). It is being purchased by L. J. Joubert of Sawyers Bar from John R. Peterson. Contains 87 acres of which about one-half has been worked by ground sluicing and hydraulicking. The property extends for a length of two miles along Eddys Gulch, beginning 1500 feet upstream from the Woodfill and Barry Placer Mine, and is 2½ to 3 miles from Sawyers Bar. Elevation, 2500 feet.

The deposit is loose, unassorted gulch gravel (see photograph), containing many slabby, angular rocks. The bedrock is mostly schist, some of it black and slaty, being the same formations found in the adjoining quartz mines. The bank averages 40 feet with a maximum height of 60 feet, of which about 25 feet is pay gravel. Large rocks are stacked by a derrick, and the freshets in the gulch are relied upon to carry off the accumulated tailings below the boxes two or three times each season. A supply of 400 miner's inches of water, taken from both forks of Eddys Gulch through one-half mile of ditch and 300 feet of flume and under 140 feet head is used for hydraulicking. With a new cut made this summer, and other improvements, Joubert hopes to be able to handle about 30,000 cubic yards of gravel yearly, provided water conditions permit a working season of six to eight months.



Joubert Hydraulic Mine, on Eddys Gulch, near Sawyers Bar, Siskiyou County, showing bedrock cut and unassorted, angular character of wash.

The property was worked for many years by Peterson, and previously by others. Peterson's figures show he mined a total of 120,250 cubic yards by hydraulicking and ground sluicing, recovering $47,300 or a reported average of 39.3 cents a cubic yard. He also produced $9,000 by drift mining, but there is no record of amount of previous output. Joubert has been operating the property two years and reports having handled 27,673 cubic yards during 175 days piping in the season of 1924–25. Reported cost was 12 cents a yard. Yield was good and operation profitable, although the average per yard was less than that reported by Peterson. Four to six men were employed.

Joubert estimates there are 550,000 cubic yards remaining that can be hydraulicked. The basin drained by Eddys Gulch contains only seven to eight square miles and is surrounded on three sides by high mountains. There is a good dam site available on this property, and the utilization of this would permit a longer season, as the water flow now ends suddenly with the disappearance of snow.

The placers of Eddys Gulch were fed from the erosion of the numerous auriferous quartz veins which lie in the basin, among which are the Klamath-Central-Ball vein system, the Ida May, Boss, and other veins. The gold in the placers is often coarse, rough and still attached to quartz. The wide U-shaped gulch and the angular character of the filling give the impression that it is an old glacial trough, although this is not known to have been definitely proved. The placer mines of Eddys Gulch have a reputed output of $3,000,000.

Long Tom Placer Group. Owner, Judin Johnson, Sawyers Bar. Contains 15 acres, patented, in NE¼ Sec. 35, T. 40 N., R. 11 W., and seven unpatented placer locations extending along Whites Gulch for 1½ miles, and 3 to 4 miles east of Sawyers Bar by road and trail. Under lease and option to Eric K. Craig, Piedmont, California.

Many auriferous quartz veins have been worked in the mountains surrounding Whites Gulch and the erosion of such veins has fed the placers in the gulch, which are otherwise similar to the deposits in Eddys Gulch. The character of the wash is loose and angular, it contains a great many rocks and it is reported to average 20 feet to 25 feet deep. The exact acreage is unknown as the bed of the creek has been worked and some of the higher ground has been drifted, but there are estimated to be 15 acres of hydraulic ground and tests by Craig indicated a value of 25 cents a cubic yard. There is not much dump, and large rocks must be stacked.

There are two miles of ditch, 1500 feet of 9″ and 11″ pipe and two giants. Johnson claims a supply of 800 inches of water from Whites Gulch, with a fall of 250 feet and a water season of about six months. The claims have recently been fitted up for hydraulicking, and there are two good houses and other buildings.

Lowden Placer. Owner, J. F. Lowden, Hamburg Bar. This is a hydraulic mine two miles west of Hamburg Bar on a high bench on the south side of Klamath River. The owner has worked for many years on a limited scale.

Lowden Placer. Owner, Ariel Lowden, Seiad P. O. Comprises 393 acres, patented, in Secs. 11, 12 and 14, T. 46 N., R. 12 W., in Seiad

Valley on both sides of Klamath River, 56 miles from Hornbrook by road.

This is one of the larger holdings along the river. It occupies an old back channel of Klamath River and the delta of Seiad Creek, entering from the north. It has been hydraulicked in years past and results were reported good, but it has lain idle for some time. One hydraulic pit on the north side of river shows quite a heavy red soil overburden and it is said bedrock was not reached on account of water and lack of dump. This property has been mentioned as a dredging possibility but no data are available as to the gold content.

Lucky Bob Drift Mine. Owner, Joseph Freshour, Gottville. One 20-acre placer claim on north side of Klamath River near Gottville. Has been worked irregularly as a drift mine for many years and has been a small producer.

It was being operated under lease by Joseph Freshour, Jr., and three partners in October, 1925. There is a shaft 60 feet deep with a steam hoist and pump operated by gasoline engine. Pay gravel is breasted about six feet high and good ground runs $5 a cubic yard with best on bedrock, but ground is spotty at most of the mines of this class along this part of the river. Work is going on in a drift 125 feet long, south of shaft.

Mann and Ross Drift Mine (Reynolds Creek Mine). Owners, Ed. Mann and Nelson Ross, Orleans P. O. In Sec. 21, T. 12 N., R. 6 E., H. M., on Klamath River 13 miles north of Orleans. It contains five placer claims of which two were bought from Wm. Lord in 1914 and three located by the owners.

This deposit is a type of which there are many examples between Orleans and Happy Camp. The ground drifted is the first bench, about 20 feet above the Klamath. The bedrock is slate close to the river, but serpentine farther back. The gravel is loose, heavy wash of slate, granodiorite and amphibolite. There is a heavy overburden of slide material. The owners attempted at first to work by hydraulicking, but the canyon sides are steep and serpentine naturally prone to slide, so that the overlying country rock slid into the workings to such an extent that they could make no headway. A little hydraulicking, for one or two months in winter, has been done and drifting paid fairly well. Some platinum has been produced. Water is obtained from Reynolds Creek through a short pipe line.

Maplesden Mine. On north side of Klamath River, three miles west of Hamburg Bar. Most of it has been worked out and it is idle.

Mary Alma Claim. Owner, Carl T. Frey, Seiad. One hydraulic claim in Sec. 10, T. 46 N., R. 12 W., near Seiad, on Klamath River.

This is a low bar which was worked to water level by Chinese in early days.

Masonic Bar Claims. Owner, Walter M. Creed, Seiad P. O. Contain 28 acres patented and 80 acres unpatented in Sec. 4, T. 46 N., R. 12 W., 2½ miles west of Seiad on south side of Klamath River. The patented land is valuable for farming and has not been prospected for mining recently, but is too low for hydraulicking. It was partly worked in early days.

Maplesden Hydraulic Mine, on north side of Klamath River, near Hamburg Bar.

Masonic Bar Gravel prospect on south bank of Klamath River, near Seiad Valley.

The higher ground has been hydraulicked in a small way by various lessees. Water is taken from Grider Creek through 3½ miles of ditch, 1000 miners inches being claimed although the ditch has not this capacity. The water has a fall of 90 feet at the mine.

McCann Placer. Owner, F. B. McCann, Happy Camp. One 20-acre placer claim on the west side of Klamath River, nine miles south of Happy Camp, adjoining the Jerry Lane patent on the south.

This is a bench deposit, on the first bench above the present river. Such prospecting as has been done has indicated a satisfactory gold content, and there is sufficient gravel in sight for one or two men working several years, between the river and the highway. In spite of the mineral character of the land, the Forest Service has been contesting McCann's claim. Only assessment work is being done. The Little Anita Quartz Claim, belonging to the same owner, adjoins on the southwest. This shows a well defined quartz vein striking northwest between diorite and black slate walls. It has been developed by a series of open cuts and pits.

McCook Placer. Owner, Charles Benback, Yreka. Contains 24 acres in Sec. 1, T. 45 N., R. 8 W., in Humbug district, at an elevation of 2660 feet.

Benback bought the claim in 1920 and has worked alone, sluicing the gravel. A derrick for handling boulders is operated by an overshot water wheel, using water from the creek.

Michigan-Salmon Hydraulic Mine (Red Hill). Owner, Bennett Company, Forks of Salmon. Located on South Fork of Salmon River, extending along the stream from 1½ to 5 miles southeast of Forks of Salmon, and contains 600 acres, covering the bed, bars and benches of gravel along the river.

This was worked at intervals for over 25 years. The last operators were Michigan-Salmon Mining Company, who worked until about 1919. The earlier miners worked the high bench deposits. The last work done was on the gravel of the lowest bench, only a few feet above the water. The deposit was about 27 feet deep.

The company used Ruble elevators on account of lack of grade and dump room. The elevator was 90 feet long, 8½ feet wide and with sides six feet high. It was essentially a long sluice box set with the bed at an angle of 17° from horizontal, and the gravel was driven through the box against this grade to elevate it. The bottom of the box for 62 feet was a grizzley fitted with cross riffles of 2″ x 4″ lumber, iron faced and set two inches apart. Under the grizzley and at right angles to the length of the elevator, was a wide sluice 50 feet long to receive material passing through the grizzley. Three No. 3 giants using water under 457 feet head, were used, one exclusively for driving gravel through the elevator. Cobbles too coarse to go through the grizzley were driven over the upper end of elevator. There was no soil overburden and not many large boulders, and the elevator handled 1000 to 2000 cubic yards of gravel in 24 hours, at a reported cost of 6 cents a yard, previous to the war. For a detailed description of the operation of the Ruble elevator, the reader should refer to our Bulletin 92, Gold Placers of California, pp. 45–47, by Charles S. Haley.

Morganza Drift Mine. E. W. Morgan, owner, Oak Bar. Three placer claims in Sec. 13, T. 46 N., R. 10 W., a mile and one-half west of Oak Bar, on a section of old back channel on south side of Klamath River, at an elevation of 1260 feet. J. A. Gilkerson and three others were prospecting the ground in October, 1925. An incline 100 feet long reaches a vertical depth of 30 feet, then turns down the bedrock, following the rim for 60 feet on the incline, or 15 feet vertical. This work is in gravel from which some prospects had been obtained, but the trough of the old channel had not yet been reached.

A small pump, operated by a 3-h.p. gasoline engine and a hoist operated by an automobile engine, were in use.

Multum in Parvo Placer Mine. Owners, Wm. Wike and Samuel Mathis of Sawyers Bar. Comprises three claims, Good Hope, Multum in Parvo Nos. 1 and 2, on the south side of North Fork of Salmon River, 5½ miles west of Sawyers Bar. The bench deposits were discovered in 1912–13 by George D. Carter who sold to the present owners in 1917. There are two benches of gravel, one 90 feet above the present stream, carrying 20 feet of gravel and 80 to 90 feet of red clay overburden, and the second 200 feet perpendicularly above the river. There was perhaps 2000 feet in length of gravel when first opened.

The supply of water, limited in amount and under 200 feet head, permits about seven months run in a good season. The mine has been worked by the partners using a No. 2 giant and has produced a few thousand dollars annually when water has been available. The bank is steep, and during the last work in 1924–25 a slide came into the pit, blocking operations.

Native Son Placer Mine. Owner, M. L. Mills, Forks of Salmon. Comprises 20 acres, one mile northeast of Forks of Salmon, on North Fork. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 854.

New Era Mine (Lower Siskiyou Mine). Owner, W. J. Brown, Happy Camp. In Sec. 19, T. 15 N., R. 7 E., at an elevation of 1000 feet on Klamath River, 12½ miles south of Happy Camp. Contains 160 acres.

This forms part of the extensive holdings once operated by Siskiyou Mining Company and is made up of a series of benches from the river to an elevation of 500 feet above it. The company operated it as an hydraulic mine, using water from Clear Creek through 11 miles of ditch and a smaller supply from Crawford Creek through two miles of ditch. The bank ranged from 50 to 150 feet high. The company began operating about 1895 and Brown came into possession of the ground in 1914. He is doing assessment work only.

Nigger Hill Placer Mine. Owner, Bennett Company, Forks of Salmon. Contains 80 acres, patented, in Secs. 20, 21, 28, 29, T. 10 N., R. 8 E., H. M. It lies on Niggerville Creek at an elevation of 2000 feet, and 2½ miles by trail from Forks of Salmon.

The property extends for one-half mile along the creek above its mouth. The deposit consists of terrace gravels principally, with some low bars worked in the early days. The more recent workings have been on both sides of the creek nearly one-half mile upstream from the South Fork of Salmon River. Two old bench deposits have been mined. The highest one is about 300 feet above the present river, and appears to be the oldest gravel in the basin. It probably corresponds with the oldest of the five benches near Cecilville, which is 250 feet above the river. There is a bank 90 feet high, containing 30 feet of slightly cemented gravel at the base, overlain by 60 feet of a distinctly red, clayey overburden. The boulders in the gravel are medium sized and have the appearance of great age and the bedrock is soft and highly altered.

There has been little work done since 1916, when G. McNeill took out about $1,600 in gold and 46 pennyweights of platinum group metals in a three months run from about one-third acre on the north side of creek. Three acres had previously been worked on the south side. The property has been of interest because metals of the platinum group, many pieces ranging in weight from a pennyweight to one-fourth ounce, were found by McNeill.[1] Niggerville Creek drains part of a large area of serpentine.

Nolan Gulch Placer. Owner, Charles Crutchfield, Callahan. On South Fork of Scott River, near its head in Sec. 14, T. 39 N., R. 9 W.

While ground sluicing in open cuts, Crutchfield has found quartz gold and is lately reported to have uncovered a quartz vein one to four feet wide, carrying a very good prospect.

Nordheimer Placer Mine. Owner, Nordheimer Mining Company. H. B. Morey, Menlo Park, secretary. Comprises 60 acres, patented, on Salmon River, five miles by road northwest of Forks of Salmon. Deposit is 15 to 35 feet deep, and the dump room is small, as the surface of deposit is only 50 feet to 75 feet above the river. The water supply is about 1000 inches in a good season, from Nordheimer Creek, and permits seven months work. The mine has been idle for many years. It was leased a short time in 1924 but no production made. The ground, largely mined off, paid up to $8,000 an acre.

Oak Bottom Placer Syndicate. Owner, Robert L. Younger, of Somes Bar, California, and Medford, Oregon. In Secs. 21, 32, T. 12 N., R. 7 E.; Sec. 6, T. 11 N., R. 7 E.; Secs. 1 and 2, T. 11 N., R. 6 E., and Secs. 35, 36, T. 12 N., R. 6 E., H. M., on Salmon River and Wooley Creek, east and north of Somes Bar. The property, containing over 480 acres, was made the basis of a proposed hydraulic mining project by John Nefroney in 1922, but was abandoned before reaching operation. It was stated water for hydraulicking could not be obtained because of previous appropriation by Electro Metals Company.

O'Neill Ranch Placer. Owner, B. J. Getchell, Hamburg Bar. Has a frontage of about three-fourths mile along both sides of Klamath River, but mostly on the south side in Secs. 22 and 27, T. 46 N., R. 11 W., 3½ miles by road west of Hamburg Bar. It was worked in early days, but lately has been devoted to farming, no mining having been done in the last five years. The ground has the first rights to water from O'Neill Creek.

---

[1] Logan, C. A., Platinum and Allied Metals in California, Cal. State Min. Bur. Bull. 85, p. 79.

Orcutt Placer Mine. Owner, Alvin Orcutt, Forks of Salmon. Comprises 20 acres in SE¼ of Sec. 30, T. 39 N., R. 11 W., M. D. M., at the mouth of Methodist Creek, seven miles by trail southeast of Forks of Salmon.

Loose bar and bench gravels, 10 to 20 feet deep, and 300 feet wide, carrying heavy boulders and lying on rough serpentine bedrock, have been hydraulicked by the owner on a small scale for many years. Water is brought through a ditch one mile long from Methodist Creek and the supply is sufficient for one small giant for a season not exceeding six months.

Paddy Cronin Placer Mine (see *Gallia Mine*).

Paine Mine. Owner, Wm. Fridley, Scott Bar. An hydraulic claim in Scott Bar district, one of the few in the district recently active.

Paradise Flat Placer Mine. Owner, Robert Younger. Forty acres along North Fork of Salmon River, just west of Sawyers Bar. Reported worked out.

Parker Placer. Owner, George J. Parker, Copper P. O. Two placer claims on Elliott Creek, in Sec. 20 or 21, T. 48 N., R. 11 W. Jacksonville, Oregon, is the nearest town. The owner has been working alone. He also has six copper claims on which 200 feet of prospect adits have been run.

Pennsylvania Placer. Owner, Frank Edwards, Copper P. O. Comprises six placer claims on Elliott Creek in T. 48 N., R. 11 W., near the Oregon line. The owner has done only assessment work.

Peterson Placer Mine (see *Joubert Placer Mines*).

Pine Grove Placer. In Sec. 10, T. 46 N., R. 9 W., in Oak Bar district. Formerly productive, but idle in late years.

Bibl: Cal. State Min. Bur. R. XIV, p. 854.

Pond Water Mine. Owner, H. H. Albars, Blue Nose P. O. One placer claim in Sec. 20, T. 13 N., R. 6 E., H. M., at an elevation of 600 feet.

Assessment work only reported done recently. Water for hydraulicking is obtained from Sandy Bar Creek.

Portuguese Mine. Owner, Henry Wood, Seiad P. O. Contains 18 acres patented, and some unpatented placer claims on the north side of Klamath River in Sec. 4, T. 46 N., R. 12 W.

The deposit has been worked intermittently for many years and for four years has been leased with option to a company represented by Thomas H. Hurburt, 422 Second Street, Portland, Oregon. The front rim of this bench ground is said to have paid, but the recent operations on the back rim have been unprofitable. The bank on back rim contains 12 feet of gravel overlain by as much as 90 feet of red clayey overburden, which in places is cemented, hampering hydraulic operations. The pay is in the lower section near bedrock.

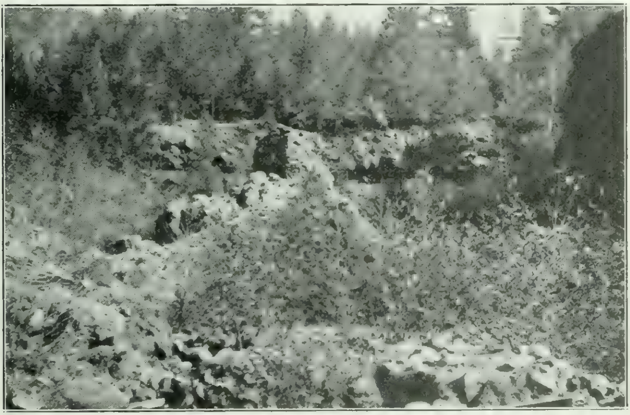
Water for mining is taken from Portuguese Creek and in favorable years the water season extends from November to May.

Bibl: Cal. State Min. Bur. R. XIV, p. 855; R. XIII, p. 420; R. VIII, p. 595.

Quartz Gulch (Wingate Hill) Placer. In Secs. 5 and 6, T. 15 N., R. 7 E., H. M., on Klamath River, eight miles southwest of Happy Camp by road. Some work was planned at this old property for the present season. It was formerly a producer.

Bibl: Cal. State Min. Bur. R. VIII, p. 601; R. XIV, p. 855.

Quartz Hill Mine. Owner, Harry G. Noonan, Apt. 12, 2801 Jackson Street, San Francisco. Mineral Lots 37 and 47 in Sec. 16, T. 45 N., R. 10 W., containing 75 acres in Scott Bar district adjoining town of Scott Bar. George Noonan, superintendent.



Bank of gravel at Portuguese Hydraulic Mine, near Seiad Valley, showing unassorted and cemented character of red clay overburden.

This is one of the oldest active mines in the county. It has been known since 1852 and has been worked by the present owners for 18 years. It is a deposit of auriferous quartz stringers and veins in schist. The upper portion was decomposed, and was worked as an hydraulic mine for many years. Then a stamp mill was put on it and a shaft was sunk about 75 feet. In later years, hydraulic mining has been resumed. The quartz stringer lead lies in bluish and grey schist associated with other metamorphic rocks, between dikes said to run parallel across the country in a northeasterly direction 1800 feet apart. The best pay seems to occur in the bluish schist. At the present time the work has reached the fresh hard rock, and there is no doubt that much of the gold goes out of the sluice onto the dump in unbroken quartz and schist.

The present work is 650 feet above Scott River. The water season is about 14 weeks annually, during which time about 1000 miners inches of water under 400 feet fall is used for piping. Besides hydraulic equipment, there is a 9″ by 8″ air compressor and drills for breaking bedrock and boulders. The sluice is 108 feet long, two feet wide and 30 inches high and is floored with iron riffles. The gold is rough, pocket quartz gold. A close watch is kept and rich rock is picked out and crushed. The schist carries a good deal of sulphides, principally pyrite with some galena. There is sufficient dump room between the sluice and the river for storage of the rock, although each year the river washes away part of it. The dump has interesting possibilities as a quartz milling proposition, although nothing definite is known of its average gold content because of the pockety character of the deposit. The property is a profitable one, and the principal producer of the district. Returns are at times sensational, as in the spring of 1925, when $16,000 was said to have been produced in a few days.

Reeves Ranch. Owner, Minnie Reeves, Happy Camp. This is one of the largest holdings of placer ground remaining on the Klamath River. It comprises several hundred acres, of which a large portion is made up of low bar and bench gravels, on the north side of Klamath River, beginning just east of the town of Happy Camp, and extending for some distance along the river. It has been held for many years as ranch and farm land.

Rocky Point Mine. Owners, Hicks and McCarthy of Scott Bar. In SE¼ of Sec. 32, T. 45 N., R. 10 W., 3½ miles south of Scott Bar.

This is an hydraulic claim, not worked on a very large scale due to lack of water for several years.

Roxbury Placer Mine. Owner, Roxbury Syndicate. Agent, George Milne, Fort Jones.

Property is a high deposit of gravel, on Scott River, one-half mile above the mouth. Haley[1] mentions it as "one of the most interesting hydraulic propositions in California today." According to Haley, "There are in the neighborhood of five to ten million yards of gravel, which will probably run from ten to fifteen cents a yard."

In 1919, the Roxbury company applied for the right to the water of Kelsey and Canyon creeks. About 12 miles of ditch are still needed to give a supply of 2500 miners inches from Thompson, Middle, Kelsey and Canyon creeks. The present supply is said to be sufficient only to operate three four-inch giants, running six hours daily between January and July of a favorable season.

The property was leased to Hammer Brothers in 1921 but was idle and no one on the ground when visited in 1925. It has considerable hydraulic equipment and some good buildings.

Rulon Placer. Owner, Percy Rulon. This is a placer mine on Beaver Creek.

---

[1] Haley, C. S., Gold placers of California: Cal. State Min. Bur. Bull. 92, p. 98, 1923.

Russell Mine. Owner, Geo. Russell, Blue Nose P. O. In Sec. 30, T. 13 N., R. 6 E., H. M., thirty miles by road south of Happy Camp, at an elevation of about 775 feet. It is a small hydraulic mine, which has been operated only 2 or 3 months annually on account of lack of water.

Russian Hill Placer Mine (Red Hill). Owner, Estate of A. Ahlgren, Sawyers Bar. Comprises 80 acres on north side of North Fork of Salmon River, 4½ miles west of Sawyers Bar. This property was worked by the hydraulic process and is said to have produced $350,000 from high bench gravel. It has been worked out, and idle for several years.

Rycroft Placer. In Sec. 14, T. 39 N., R. 9 W., 6½ miles southwest of Callahan on Slide Creek. It was formerly productive but has been idle lately.

Bibl: Cal. State Min. Bur. R. XIII, p. 423; XIV, p. 855.

Sanford & Edmundson Claim. Owners, O. A. Sanford and T. A. Edmundson, Seiad P. O. This is a bench gravel claim on the south side of Klamath River near Seiad. It is not equipped and only assessment work has been done recently.

Sauerkraut Placer Mine. Owner, Charles Lilly. Forty acres on Salmon River, six miles by road northwest of Forks of Salmon, at an elevation of 1100 feet. This mine was hydraulicked by Chinese 30 to 35 years ago, and produced a few thousand dollars annually. It has been idle in late years. Water supply was obtained from Morehouse Creek.

Schuler Mine. Lessee, James W. Reynolds, Happy Camp. This is an hydraulic mine on Klamath River two miles upstream from Happy Camp, on the north side of the river adjoining the Minnie Reeves Ranch. It contains 3 claims formerly mined by Smith & Attlebury. Reynolds was preparing in October, 1925, to put in a new flume to bring water from McCade Creek, preparatory to resuming hydraulic mining.

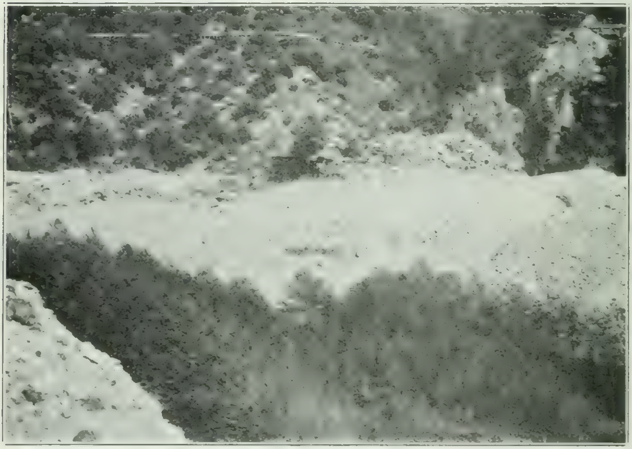
Shadows Creek Placer Mine. Near Cecilville. Operated by E. M. Robertson, Albert Brown and D. O. George as an hydraulic mine.

Shumway Mine (formerly *Bonaly Mine*). Owners, Forks of Salmon River Mining Co. B. M. Newcomb, president and A. C. Aiken, secretary, Flatiron Building, San Francisco. It contains 22 claims, about 220 acres in all, along the North Fork of Salmon River beginning a mile east of Forks of Salmon and extending upstream for about four miles. Yreka and Gazelle, the nearest railroad stations, are 70 miles northeast, by road. The elevation is about 1200 feet.

The deposits consist of bench, back channel and river bar gravel, 10 to 60 feet deep, lying on schist bedrock, and free washing. Parts of the property have been worked intermittently since 1855. It was taken over by the present company in 1916 and they began work in the spring of 1917, and operated until December, 1920. The property was then leased to E. T. Aiken, who worked it until April, 1921. It has been idle since. The reported production from 1908 to 1921 was

$250,000, but part of the ground handled by the company was old ground and is believed to have made only a nominal return. During the period of this company's activity, the operation was one of the largest of this kind in the state, it having been said that a maximum capacity of 30,000 cubic yards a month was reached in 1919.

Hydraulic mining equipment includes 5000 feet of iron pipe from 11 inches to 60 inches in diameter; 8 giants, a water power hoist and derrick with a capacity of 7 tons, and a blacksmith shop, electric light plant and buildings. A fine water right on the north fork of the river supplied ample water for three No. 5 giants (6-inch nozzles) under 235 feet fall. Hydraulic mining could be carried on nearly the entire year, except for a period of freezing weather for about six weeks in December and January. Large accumulations of coarser tailing have been stacked on the claims with giants, as there is lack of dump room.



Shumway (Bonaly) Hydraulic Mine, on a back channel of Salmon River, with a high rim separating it from the present stream.

Siskiyou Mines Company. In sections 2, 1, 6, 7, 5, 12 and 18, Ts. 16 and 17 N., Rs. 7 and 8 E., H. M., on Klamath River adjacent to Happy Camp. The original area was 1500 acres of which 640 are patented. This property was one of the three largest hydraulic mines in the county up to the time of high costs following the war. Geologically it is similar to the Davis Mine and was a consolidation of a number of old claims that had been worked in part years before, and a large area of unworked ground consisting of low river bar and high bench gravel.

The bank was from 10 feet deep on the lower bars to 60 feet deep on the higher benches. The gravel was in part loose and in places cemented and lay on bluish schist bedrock. Water under 250 feet fall was taken from Thompson Creek through three miles of 3′ by 4′ ditch and 10 miles of 36″ by 44″ flume. Hydraulic mining equipment included three No. 2 giants, two No. 1 giants, 1500 feet of 15-inch pipe, 2500 feet of 11-inch pipe and 480 feet of sluices 3′ by 3′. Tailings were dumped into Klamath River.

The company operated the mine steadily until about 1919. At the time of shutting down, the superintendent stated that the gravel was averaging about 10 cents a cubic yard and that this was just about the cost of operation at that time. Since then, lessees have worked the mine on a small scale.

Siskiyou River Bend. In Oak Bar district, on Klamath River. Since our last county report, this property has been worked out by A. C. Aiken, using an hydraulic elevator.

Six-Mile Creek Placer. Owner, A. E. Westover Callahan or 480 Pine Street, San Francisco. This contains 40 acres at the junction of Six-Mile Creek and East Fork of Salmon River, 18 miles from Callahan via the Cecilville trail. It adjoins the old Root & Salsberg placer. It is reported to be high ground about 300 feet above the east fork and believed to run parallel to it for about 1500 feet, though this is not certain on account of obscuring slides from the adjacent hill. Where exposed it is stated to be 200 feet wide and 14 feet deep. About two miles of ditch would be needed to supply water for hydraulicking. Equipment includes blacksmith shop, three giants, 800 feet of 11-inch and 15-inch pipe and one-fourth mile of flume, all on the adjoining ground belonging to the same owner, and there is also a cabin. The water of Six-Mile Creek is available for hydraulicking under good head. Westover stated in 1924 that a test of 200 cubic yards proved very encouraging, and during the summer of 1925 he began work on the property.

Snowball Placer. Owners, Barton & Shearer. Address H. J. Barton, Yreka. Leased to Tieke & Scanlon, Oak Bar. This property is four miles west of Horse Creek on Klamath River. It is a low back channel of Klamath River and was partly worked by Chinese. The present lessees have been sinking an incline, and reached bedrock in the autumn of 1925.

S. R. Crary Mine. Owner, S. R. Crary, Walker P. O. This property contains 80 acres, including both quartz and placer ground. Several hundred feet of drifting has been done on a quartz vein, and some placer mining has also been done, using water from McKinney Creek, but the water supply is small.

Stenshaw Mine. Owner, Samuel Stenshaw, Blue Nose P. O. Contains 98 acres, unpatented, in Secs. 28 and 29, T. 13 N., R. 6 E., H. M., on Klamath River 12 miles north of Somes Bar.

The property contains three benches of gravel, averaging about 10 feet in depth and with as much as 40 feet of overburden. Like many other gravel bench and bar properties in this section, this place has been partly used for farming, and hydraulic mining has been carried on for a few months in winter when water conditions were favorable. It is equipped with one giant and about 1500 feet of pipe. Water is taken from Stenshaw Creek.

Squaw Gulch Placer. It is four miles northwest of Callahan and has been a small producer in the past, both as a drift and hydraulic mine, but has not been actively worked of late. It is on Sugar Creek at an elevation of 3420 feet.

Bibl: Cal. State Min. Bur. R. XIII, p. 427; XIV, p. 857.

Sugar Hill Mine. This mine is a mile southeast of South Fork of Scott River and 5½ miles by road and trail southwest of Callahan. It is on the same kind of decomposed dike as has been mined at the nearby Fippen & Hayden property. Gold occurs in quartz seams and stringers in the rusty, decomposed dike material, and for many years this was worked with a small hydraulic rig, passing from one ownership to another with a small production of gold. Early in 1924, Nickerson, then the owner, leased it with option to purchase to Wolfskill & Lidstone, who started work drifting along a vein of white quartz up to four feet wide which occurs in the dike and which has yielded small pockets of free gold. A crew of 10 men were employed for a while, but in October, 1925, it was reported that work had been suspended some time ago.

Ten Eyck Placer Mines, Inc. Main office, 504½ D Street, Marysville, California. W. T. Tyler, secretary, 715 Bryant Street, Palo Alto. Property contains 80 acres in Sec. 28, T. 12 N., R. 6 E., on the west side of Klamath River, at the mouth of Ten Eyck Creek.

The deposit consists of three bench deposits of gold-bearing gravel, the lowest of which is 50 feet above high water level of the Klamath and has a slaty schist bedrock. The second bench is 300 feet higher and has serpentine bedrock and finer gravel. The higher bench was worked in 1909 but work was suspended there because tailings from it would cover the unworked part of lower bench. Later work was on the lowest bench. A No. 3 giant under 225-foot head has been used, water coming through a ditch and 1000 feet of 11-inch pipe. There is considerable overburden of broken country rock but it is not as heavy or bothersome here as at some other properties along the river, on account of the creek having graded down the canyon slope. The bank is 40 to 80 feet in depth, 300 to 400 feet wide, and gravel is loose, with some large slabs of serpentine and slate.

While earlier work was reported profitable, the present company is now (Oct., 1925) levying a stock assessment.

The mine has produced some platinum group metals (see under Platinum). West of the gravel deposit, serpentine occurs with diorite or other basic dikes. A number of small gold pockets have been found in this area.

Thomas Mine. Owners, Thomas Brothers, Blue Nose P. O. It is in Cottage Grove district, Sec. 29, T. 14 N., R. 6 E., three miles north of Blue Nose on the Klamath River.

Two claims, in loose bench gravel about ten feet deep with four feet of overburden, have been mined in late years. Two benches, one near the river and one higher, have been opened. Inadequate water supply permits only about four months working season. The work has been done by hydraulicking, using two small giants and 9-inch pipe.

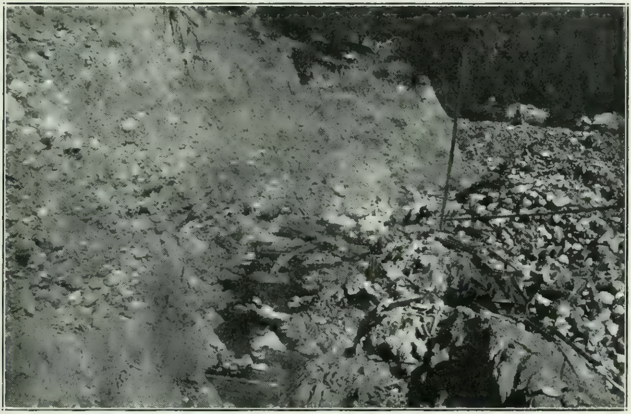
Two and a Half Mine (Walker Placer). On Grouse Creek, six miles east of Callahan in Sec. 20, T. 40 N., R. 7 W., M. D. M. It was formerly a good producer, with a reported output of $200,000 from hydraulic operations, but has been idle in late years.

Bibl: Cal. State Min. Bur. R. XIV, p. 857.

Welch & Bradley Placer (Progressive Placer Mine). Owners, C. W. Welch and S. D. Bradley. Placer ground on Beaver Creek. Has been active in recent years.

Whistle Bar Placer Mine. Owners, Ed Kearns, Sawyers Bar, and Robert Kearns, San Jose. On North Fork of Salmon River a mile and a half west of Sawyers Bar. This was operated many years ago as a river claim. It contains, in addition to the portion of river bed, a back channel, said to be 25 feet below the present river and a section of high bench gravel 75 feet above the river on the south bank, with a width of 80 feet, length of 1800 feet, and depth of 20 feet.

The owners have in recent years sunk an incline and have done some drifting in the deep channel, with a small production. In the autumn of 1925 a flume was being built from the end of the old Bigelow ditch to bring a supply of water from Jessops Gulch, a distance of about two miles, in order to hydraulic the high bench deposit. There is estimated to be 600 inches of water available under 200 feet pressure. The gravel is said to prospect well.



Woodfill & Barry Hydraulic Mine, on Eddys Gulch, near Sawyers Bar.

Willard Placer (see *Hoosier Hill*).

William Burns Placer (see *Joubert Placer Mines*).

Woodfill and Barry Placer Mine (Gold Bank and John Frank Mines). Owners, J. Woodfill and C. J. Barry, Sawyers Bar. Contains 80 acres extending upstream on Eddys Gulch for nearly a mile from its mouth, and one-half mile to 1½ miles from Sawyers Bar. Elevation

2000 feet to 2300 feet. The claims have been worked in a small way for many years by others, including Ramsey and Frazier, but were relocated in 1924 by the present owners.

The deposit is composed mostly of angular unassorted gulch filling, somewhat waterwashed on the rims. The ground worked the past season varied from 14 feet deep in the channel to 35 feet deep on west rim with a width of 40 feet, and overburden increases to the west. This is a segment of an old back channel of Eddys Gulch, 40 feet above the present stream, and on account of the overburden of soil on the banks going upstream, it is impossible to say how much of such ground remains. As shown in the photograph, the ground is excessively rocky, but paid a good profit to the owners, who are said to have realized a gross yield of $8,600 from the season's run of about 20,000 cubic yards with one man employed besides themselves. The work is some distance from the river, as the gulch bed has been extensively worked previously. Besides this high ground, the owners claim they have a length of possibly 800 feet of unworked deep ground under the gulch, where a prospect incline 19 feet deep gave encouragement.

In a good water season about 500 inches of water from Eddys Gulch is available for piping for six to eight months. There are 2400 feet of new flume, 600 feet of pipe, one 3½-inch giant, a derrick operated by water power, and several hundred feet of sluices 12 by 18 inches, and blacksmith shop on the claim.

GOLD DREDGING.

Several gold dredgers have been operated in the county, but no dredging is going on at present.

El Oro No. 3 was operated a number of years on Greenhorn Creek which drains an area of gold-bearing schists near Yreka, emptying into Yreka Creek, Shasta River and Klamath River. The ground was finished in 1920. This dredger was El Oro No. 1, rebuilt. It was 202 feet long, with 40-foot beam and carried 89 buckets of 6 and 6¼ cubic feet capacity. It was rigged with a 16-foot extension on the digging ladder, and could dig to a depth of 38 feet below the water level. Its capacity was 75,000 to 80,000 cubic yards a month, and it was operated by electric power. This dredger was equipped with an 18-h.p. boiler to supply steam for use in keeping the stacker belt free from frost, as the winters are cold. In summer the supply of water was short.

The gravel had an average depth of 18 feet and a width up to one-fourth mile and the bedrock was slate, schist and porphyry. The gold was fairly coarse and was caught on the first four tables. The gold yield from this ground was reported satisfactory.

Bibl: Cal. State Min. Bur. Bull 85, pp. 36–37.

Northern California Dredge Company had a small suction dredger on their property in Sec. 36, T. 46 N., R. 11 W., one-half mile west of Hamburg Bar, but this was unsuccessful, and work stopped in 1911.

Bibl: Cal. State Min. Bur. Bull. 57.

Oak Bar Dredge was operated a short time on Klamath River near Oak Bar (Walker P. O.). This worked only a small area, and the results are not known, though believed to have been unprofitable.

Poker Flat Dredger was operated in the same section as the last named, one-half to one mile below Callahan on the South Fork of Scott River, for about two years. This was a Risdon dredger with buckets of 2½ cubic feet capacity, and cost about $45,000. It recovered about $10,000, and was said to have been about worn out in the two years.

Porters Bar Dredging Company drilled 175 acres of bottom land on the South Fork of Scott River in Sec. 7 and S½ of Sec. 6, T. 40 N., R. 8 W., a mile and a half below Callahan. The holes varied in depth from 12 to 42 feet, most of them being from 27 to 35 feet deep and drill prospects were good, but values averaged low, although a few thousand cubic yards were of good grade. A width of 300 to 450 feet was drilled but only 210 feet in width was dredged to an average depth of 30 feet. The project was soon abandoned. Bedrock is hard in this section, gravel is quite rocky, and is said to be cemented in spots.

There is a length of 2½ miles along this stream near Callahan, where there is a total of perhaps 350 acres of bottom land composed of such auriferous gravel. This land is now owned by R. V. Hayden, F. D. and R. C. Sullivan, of Callahan. A total of 2000 inches of water is claimed to be available under 180 feet head with two miles of ditch. The dump room is small, however.

Siskiyou Dredging Company operated successfully for many years on an area of 165 acres on McAdams Creek in Deadwood district, Secs. 14, 6 and 25, Ts. 44 and 43 N., Rs. 8 and 9 W. This ground included the Oak Grove, Diggles, Mathewson and Shaw drift mines. The gravel was 30 to 60 feet deep, loose and reported easy to work. The dredger was of Bucyrus type, with 5½ cubic feet buckets and equipped to dig 50 feet below water level. It was operated by electric power, and had a capacity of 2000 cubic yards a day. It operated between 1910 and 1920.

Bibl: Cal. State Min. Bur. Bull. 57, p. 223. Report XIV, pp. 864–865.

GRANITE.

Good quality granite occurs on Craggy Mountain in T. 41 N., R. 8 W., and in Sec. 1, T. 41 N., R. 9 W., also in T. 40 N., Rs. 8 and 9 W. This has been used locally in a small way for building blocks and monuments. The deposits are all a long distance from railroad.

Bibl: Cal. State Min. Bur. Bull. 38, p. 54.

IRON.

Float iron ore is mentioned as occurring in Sec. 10, T. 46 N., R. 10 W.

Bibl: Cal. State Min. Bur. Bull. 38, p. 304.

LEAD.

On the *Fippen & Hayden Placer* (see under Gold Placer Mines), in the Callahan district, an adit of unknown length was run, many years ago, to prospect for lead. A small amount of good galena ore was brought out of this adit and dumped. In 1924, M. E. Gardner sluiced off the soil overburden and exposed the edge of the vein in place above the old adit. The exposed section is about 30 feet long and the width of vein is from a few inches to one foot. It consists of barite, carrying lumps and stringers of galena. Assays of the ore indicate a high lead content, sufficient to make the best samples a good shipping ore, and with a fair content of silver. Ore could be concentrated by jigging. Gazelle, the nearest railroad point, is 27 miles distant by road. This prospect is idle.

Other prospects of lead ore have been reported in the region eight to ten miles east of Callahan near the Gazelle road, but so far as could be learned, the float found there had not yet been traced to the vein, although some prospecting was going on in the late summer of 1925.

LIMESTONE AND MARBLE.

There are large deposits of limestone and marble in the county, but for the most part these deposits are remote from present railroads. The deposits nearest to transportation are in the area of Devonian rocks just west of Gazelle. For local use in Scott Valley, deposits near Etna Mills, Greenview and Callahan have been worked in a small way. An area of Devonian rocks, containing coral limestone, extends from near Callahan northward for nearly 20 miles.

Large deposits of marble occur in a belt running west of Etna Mills along the east slope of the Salmon Mountains, northwest through the Marble Mountains, the Grider Mountains and past Thompson Creek. Should the demand ever arise, and means of transportation be provided, Siskiyou County could supply nearly any demand for limestone. Under present conditions, however, the deposits, many of which are hardly prospected, could not compete with others in the state that are nearer railroads.

Jason Chastain of Gazelle has been doing some work recently on promising limestone deposits four miles west of Gazelle. This is in one of the areas of Devonian rocks mentioned.

Wurst & Majors of Etna Mills have operated a small mill from time to time in recent years on a deposit in McConaughy gulch, near Etna Mills. They have crushed limestone for local farm use, as a soil corrective and fertilizer.

Deposits that have been mentioned in past reports are listed below:

Name of deposit and location	*Remarks*
Burton, Sec. 17, T. 43 N., R. 9 W. 4 mi. NE. of Greenview	limestone
Farrington, Sec. 24, T. 40 N., R. 9 W. 2½ mi. SW. of Callahan	limestone
Marble Mountain, Secs. 16, 19, 20, 21, T. 43 N., R. 10 W.	marble
Barton & Barham. Sec. 18, T. 46 N., R. 9 W. in Oak Bar district.	
Luce, two miles N. of Fort Jones in Deadwood district	good marble
McDaniels, Sec. 6, T. 41 N., R. 9 W.	white marble
Parker, Sec. 32, T. 42 N., R. 9 W. near Etna Mills	pink, white marble
Thompson Creek, Sec. 8, T. 17 N., R. 8 E., H. M., 8½ mi. NE. of Happy Camp	white marble

Bibl: Cal. State Min. Bur. Bull. 38; R. XIII, p. 632; R. XIV, pp. 865, 867.

MINERAL WATER.

There are in the county a number of mineral springs, several of which have been known for years as summer resorts. Considerable water has also been shipped from Shasta Springs. Among the principal resorts are Shasta Springs, Warmcastle Soda Springs, Klamath Hot Springs, Garretson Springs, Neys Springs and Upper Soda Spring. These, except Klamath Hot Springs, are cold carbonated springs. All of these springs have been described in the past publications of the Bureau and at a later date (1915) in U. S. Geological Survey Water Supply Paper 338, which covers the subject in great detail, so that there is no need of repeating this information here. Waring in the last mentioned report lists 15 groups of carbonated springs in the county. They may be grouped in three localities; those near Beaver Creek, in the northeastern part of the county, those in the western part of the lava-covered area in the vicinity of Ager, and a third and most important group because of their accessibility, near Sacramento River in the southern part of the county.

Bibl: Cal. State Min. Bur. R. XIII, p. 520; XI pp. 449, 452; U. S. G. S.; W. S. P. 338; Winslow Anderson, Mineral Springs of California.

ORNAMENTAL AND GEM STONES.

Californite, a massive green vesuvianite, was first found on Indian Creek, north of Happy Camp. It is a hard, massive mineral with a vitreous luster and varies in color from nearly white to olive green. It has been mistaken for jade here and in other localities. The mineral occurs on claims belonging to the *Reeves Davis Estate* and *Henry Howard*, on the South Fork of Indian Creek, 10½ miles north of Happy Camp. It also is found as float, in large and small boulders, on placer claims belonging to *Scott Greening*, on O'Meara Creek, a tributary of Indian Creek, which enters it at the Classic Hill Mine, 12 miles north of Happy Camp, and pieces of float have also been found elsewhere along the course of Indian Creek and in the mountains on the west side of the creek. Nothing has been done to develop it.

Bibl: Cal. State Min. Bur. Bull. 37, pp. 93, 94; R. XIV, p. 869.

Onyx occurs 200 yards downstream from Shasta Springs near Sacramento River. The deposit has been known as the *Griffin Onyx Marble Quarry* and contains a vein about five inches wide. Small articles such as paper weights have been made from it. Idle.

Fire opal is mentioned by Eakle[1] as occurring near Dunsmuir.

C. B. Kay of Ager has lately been doing some work on a deposit of fossiliferous sandstone which occurs on the *Henry Hagedorn* and *Sidney Richardson Ranches* five miles south of Ager in the NE¼ of Sec. 26, T. 46 N., R. 6 W. There are several beds of the stone, ranging from three inches to one foot wide and dipping east about 23°. Some of these beds are so thickly matted with shell remains as to give the polished stone a very pleasing and unique appearance as the sandstone is nearly black and in contrast with the white shells. The stone being fine-grained is hard and compact enough to take a polish, and might find a market for small articles. It contains a high percentage of cementing calcite in addition to that in the fossil shells.

---

[1] Eakle, A. S., Minerals of California: Cal. State Min. Bur. Bull. 91, 1923.

PLATINUM GROUP METALS.

Osmiridium and platinum occur with gold in the gravel deposits along Klamath River and Salmon River. The subject of the occurrence of these metals was covered by the writer in considerable detail in the Bureau's Bulletin 85. These metals occur in very small proportion to the gold content of the gravel, and the output from the county is negligible.

Field work for the above report showed that while platinum group metals occur in the gravel of the South Fork of Salmon River in appreciable amount from Matthews Creek downstream, at least as far as Forks of Salmon, there has been practically no platinum or osmiridium found in the placer mines of the North Fork, although these have yielded several times as much in gold as the placers of the South Fork. The presence of platinum group metals on the South Fork side, and their absence from the other fork, is attributed by the writer to the presence of considerable outcropping serpentine and peridotite in the drainage basin of the south fork, while these rocks are found only in a few very small areas on the north fork side. The platinum and osmiridium formerly recovered at the Nigger Hill and Michigan-Salmon hydraulic mines probably came from nearby serpentine areas. Nuggets up to ½ ounce in weight were found. An analysis of a shipment from the latter mine showed 97.05% osmiridium and 2.95% platinum. This comes nearer to being pure osmiridium than any other known sample in the state. While platinum usually occurs in the placers as thin, smoothly hammered flakes, similar in size and shape to fine placer gold, on account of its softness, osmiridium or iridosmine usually are found in ragged, angular pieces because of the great hardness of these native alloys. The latter may be dull, rusty, or coated, and might easily be mistaken for lead were it not for the fact that none of the metals of this group can be melted in an open fire as can lead, and the above named alloys are much harder than lead and as a rule so feebly magnetic (if at all so) that they are easily distinguished from iron or its compounds.

One ounce of platinum group metals to $3,000 in gold is about the usual proportion in this state where the two occur together. The proportion of platinum is a little higher than this on the South Fork of Salmon, and lower on the Klamath. None of the other placers of the county are known to have produced platinum, and none was recovered from the dredging operations on McAdams and Greenhorn Creeks.

It is believed that the platinum metals in place occur only in narrow stringers or seams in serpentine and in the rocks from which serpentine is derived, such as peridotite, dunite and gabbro. Only one report has come to the writer's attention of platinum in place in this county. This was in a quartz stringer prospected by Morgan Bros. of Gottville, while hunting pockets on Empire Creek. They state that the report was made by a Denver assayer. The quartz prospect gave out entirely after being followed a few feet.

PUMICE.

Siskiyou County is one of two counties in the state that have produced pumice in recent years, the other being Imperial. Pumice is a cellular, glassy lava, commonly having the composition of rhyolite, but with a great proportion of voids. Deposits of pumice near Bartle in this county were under investigation by the Southern Pacific Company as early as 1909, when tests were made by J. N. O'Hara for Wm. Hood, chief engineer of the company, to determine whether or not the pumice was suitable for use in concrete where a heat-resisting and nonconducting material was desired. Although it was found that the pumice did not give satisfactory results as coarse aggregate in concrete, it was learned that concrete containing pumice as fine aggregate and also in place of sand, had remarkable heat-resisting and insulating properties. The mix contained one part Portland cement, two parts pumice sand (under one-fourth inch) and three parts pumice gravel (one-fourth inch to one inch). Briquettes of this mix, aged 30 days, had a compressive strength of 301 pounds per square inch in air and 283 pounds per square inch in water, and weighed only 57½ pounds per cubic foot. A 6-inch cube of this concrete was subjected to the continuous heat of a Bunsen burner for two hours and was then immersed in water. No fire or smoke passed through, and there was no disintegration, warping or bulging. A similar sized cube of standard materials (one part of cement, two of sand and three of gravel) when subjected to the same test, is said to have disintegrated to a depth of 1½ inches, cracked in water and was too hot to touch on the side away from the flame. No practical use is known to have been made of the pumice as a result of the tests. Between 1918 and 1921, when the importation of foreign pumice was prevented by shipping conditions, considerable pumice was shipped from the vicinity of Bartle. It was used in abrasives, for fire-brick and as an insulating filler in the walls of refrigerators and cold storage plants.

QUICKSILVER.

Cowgill Quicksilver Mine. Owner, Mrs. A. M. Cowgill, P. O. Box 96, Yreka. In Sec. 34, T. 48 N., R. 9 W., on the headwaters of the West Fork of Beaver Creek, 10 miles in an air line from Gottville but farther by road.

According to Bradley [1] there was some work done here years ago by Siskiyou Quicksilver Mining Company, who built a 10-ton furnace and are said to have produced a few flasks of mercury. During the wartime boom in quicksilver, Mercury Company of America did some prospecting on the surface, and put up a 12-pipe retort. Cinnabar was found in the decomposed surface soil to a depth of 60 feet. This company did little work.

Lately some work has been done by the owner and the property is for sale.

Great Northern Quicksilver Mine, Inc. (Formerly *Morgan Brothers Mine.*) Office 414 Second Street, Marysville. Frank Fisher, president, Meridian P. O. Frank and David Morgan, discoverers, own 50% of stock. Holdings comprise six unpatented claims and 60 acres of patented land in Secs. 13, 14, 24, T. 47 N., R. 8 W., four miles by road from Gottville on East Fork of Empire Creek, and 19 miles by road west of Hornbrook. Elevation 3400 feet.

---

[1] Bradley, W. W., Quicksilver Resources of California: Cal. State Min. Bur. Bull. 78, p. 169, 1918.

Morgan Brothers first discovered quicksilver in this vicinity in 1905, and did the first work on these claims in 1915. The property was equipped with retorts during the war-time quicksilver boom, and produced 27 flasks of quicksilver in 1919. Three flasks were produced in the course of experimental work in 1925.

Quicksilver occurs both as free metal and as cinnabar in several well-defined fissure veins carrying gouges. The main or Leroy adit runs N. 70° W. 200 feet and the veins are exposed in a crosscut northward from it 100 feet. What appears to be the main vein here strikes N. 37° E. and dips nearly vertically. It has a width of nine feet and makes a good showing of cinnabar. A cross vein strikes N. 85° E. and dips 32½° N. Another vein nine feet wide was cut 32 feet west. This strikes N. 15° to 20° E. and dips 67° NW. It shows considerable native mercury and cinnabar. A raise 135 feet long is said to show ore above this level. The next level above, called Ore bin level, is 150 feet long. The vein here strikes N. 43° E. and dips 42° NW. About 12 feet in width shows mercury and cinnabar plainly, but a width of 30 feet is claimed to be ore bearing. The vein is also exposed by other upper workings. The No. 1 or uppermost level is about 130 feet vertically above Leroy level. The ore is of unknown width here and shows cinnabar in decomposed rock.

The vein is composed of a breccia of hard, fine grained, black rock, possibly a hornfels recemented by calcite. So far as can be determined by the examination of large samples without the aid of a microscope, the cinnabar occurs entirely in the calcite and the free mercury in numerous small vugs left partly unfilled. The manner of deposition is indicated by the growth of cinnabar crystals from both walls of partly filled cavities lined with calcite. The black fragments carry some pyrite. The mercury content of the ore is said to run from one-half per cent to 1¼ per cent. Oxidized rock from the upper workings showing little or no cinnabar pans well. The outcrop can not be traced except by panning and surface relations are obscure, but other showings of ore are claimed 600 feet west, on the other fork of the creek. On the hanging wall side, 300 feet distant from the workings there is a prominent outcrop of limestone 200 feet wide, striking northeast and said to be traceable a mile.

The property is equipped with 12 Johnson McKay retorts, two D retorts, and one Steele retort, the latter an experimental installation; also one 75-h.p. Holt gas engine, one 6-h.p. gas engine and an air compressor, all at Leroy adit. The camp, consisting of several good small buildings, is about one-half mile from the workings.

Minnehaha Prospect. Owners, H. J. Barton et al., of Yreka. It is in Sec. 15, T. 46 N., R. 10 W., at Horse Creek bridge on Klamath River, 36 miles west of Hornbrook, and contains 20 acres, patented. Prospecting has been done in the superficial, decomposed part of the deposit and nothing is known about it in depth, although it was first found in 1878. A small amount of cinnabar, recovered by washing the soil through a sluice-box, was sold years ago to Chinese. There has been no recent work done.

Bibl: Cal. State Min. Bur. R. XIII, p. 602; XIV, p. 870; Bull. 27, p. 196; Bull. 78, p. 169.

SANDSTONE.

Sandstone beds form the rim of Shasta Valley, outcrop east of Yreka and are found at several places from Snowdon to the Oregon line (see under Geology). A number of years ago, before cement came into such general use, sandstone was quarried here as well as in other counties of the state. Three quarries were described in our last report.

Antone or *Weeks Quarry* is two miles northeast of Yreka. The sandstone was quarried in layers from six inches to eight feet thick and has been used considerably for building in Yreka.

Fiock Bros. Quarry is in Sec. 13, T. 45 N., R. 7 W., near Yreka. The stone is coarse grained, even textured and tawny in color.

Southern Pacific Company has quarried considerable sandstone in Sec. 29, T. 47 N., R. 6 W., near Hornbrook. This stone has been used for railroad culverts and for some buildings in Hornbrook.

SOAPSTONE.

Soapstone and talc might reasonably be expected to occur at many places in the county, where serpentine is found. For the location of serpentine outcrops, the reader should refer to the sections on Asbestos and Chromite, herein. To date, no commercial development of soapstone has taken place in Siskiyou County. For the most part, the deposits noted are a considerable distance from the railroad. Such deposits, of good size and said to be of satisfactory quality, are found in the northeast part of T. 45 N., R. 11 W., southeast of Hamburg Bar; also near the head of Wooley Creek, and better grades are said to have been found in a deposit on top of the divide between Beaver and Bumblebee Creeks and in a small deposit in Sec. 32, T. 42 N., R. 9 W., near Etna Mills. The business of soapstone and talc production and marketing is highly competitive, and the market prices of lower grade and 'off color' soapstone and talc are so low that only deposits near the railroad can be worked at a profit. There is a scarcity of high-grade, white-grinding talc, however, in the northern end of the state, such ore at present coming from the southern counties, while 'off color' soapstone, used for roofing where the shade is not important, is produced near the railroad in El Dorado County.

STONE INDUSTRY.

Since 1916, Siskiyou County has produced considerable crushed rock and gravel for road construction. The stream gravels near Yreka, as for example the dredged portions of Greenhorn Creek, and some areas of volcanic rock near enough the railroad are the most convenient sources of supply. There has been a considerable length of both state highway and rock-surfaced county roads built in the county in recent years, and local stone has been utilized.

Kaiser Paving Company's Black Butte Quarry is four miles north of Sisson on the Pacific highway. This plant has been operated intermittently, and has produced quite a large tonnage of crushed rock. The material is a hard dark volcanic rock, forming a prominent cone-shaped mountain just east of the state highway. The quarry is served by a spur track from the main line.

Steele Quarry is three-fourths of a mile southeast of Yreka. It has produced crushed rock for local use.

BIBLIOGRAPHY.

Publications covering the geology and mineral resources of Siskiyou County.

California State Mining Bureau.

Reports of the State Mineralogist:

II, pp. 47, 184–189.
IV, pp. 73, 99, 115, 137, 310.
V, pp. 67, 112.
VI, part 1, pp. 93, 96, 101, 118; part 2, pp. 63, 187.
VIII, pp. 14, 24, 581–631.
IX, pp. 31, 262, 318, 319.
X, pp. 655–658.
XI, pp. 420–452.
XII, pp. 61, 275–294, 346, 370, 459–471.
XIII, pp. 34, 55, 64, 386–435, 520, 521, 632.
XIV, pp. 810–872.
XVII, pp. 529–536.
XVIII, pp. 6, 96, 139, 206, 256, 581, 700, 297, 354, 495, 600, 733.
XIX, pp. 11, 58, 93, 138.
XX, pp. 179–182.

Bulletins 27, 37, 38, 50, 57, 67, 70, 71, 72, 74, 76, 78, 83, 85, 86, 87, 88, 89, 90, 91, 92, 93 94.

Register of Mines of Siskiyou County, with map.

Note—All reports prior to Fourteenth, except Eleventh, are out of stock, as are also many of the bulletins and the Register of Mines. Copies may be consulted at Bureau offices.

Publications of United States Geological Survey.

Mineral Resources of the United States from 1903 to date, various pages.
Separates of this publication, covering particular minerals, may be had.
Beginning with the present year, this publication will be issued by the U. S. Dept. of Commerce, Bureau of Mines, Washington, D. C.
Fourteenth Report, Part II, pp. 404–434.
Bulletins 196, 507.
Topographic Maps for Preston Peak, Sawyers Bar, Seiad and Shasta quadrangles.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

SAN LUIS OBISPO COUNTY.

Introduction.

The history of San Luis Obispo County is linked with that of the early Spanish settlement and occupation of California. In 1772 the Mission San Luis Obispo de Tolosa was founded and the village which grew up around it became later the city of San Luis Obispo, county seat of the county, which also took the same name.

The county was organized in 1850 shortly after California was admitted to the Union, it being one of the original twenty-seven formed at that time. Between 1851 and 1885 its north, east and south boundaries were moved several times but with little change in its area or general outline.

Probably ninety per cent of its acreage formerly was included in Spanish grants, whose dimensions were expressed in leagues, and many ranchos containing from ten to fifty thousand acres long remained intact. These large holdings are gradually being cut up, however, and much of the valley land is now intensively cultivated. Dairying and stock raising are important pursuits. But little public land remains and, with the exception of claims already located, mining of necessity must consist mainly in the development and production of minerals found on these privately-owned lands, either through purchase or lease. Climatic conditions are excellent and mining can be carried on the year round, although in the more remote districts the condition of the roads in the rainy season makes hauling impractical.

Geography.

San Luis Obispo County borders on the Pacific Ocean and occupies a position midway between San Francisco and Los Angeles. It is bounded on the North by Monterey County, on the east by Kern and on the South by Santa Barbara. It contains 3334 square miles and has a population of 21,893 (1920 census). The coast line of the Southern Pacific railroad passes through the county from north to south. The railroad follows Salinas River Valley through Paso Robles to a point near Santa Margarita, thence it crosses the Santa Lucia Range via Cuesta Pass, reaching San Luis Obispo at the foot of the grade, and the ocean near Pismo. It continues south along the ocean shore giving through transportation. The Pacific Coast Railroad (narrow gauge) connects Port San Luis with San Luis Obispo and continues to Santa Maria and other points in Santa Barbara County. The paved Coast highway closely parallels the Southern Pacific railroad through the county.

From Santa Margarita fair dirt roads extend to the eastern part of the county, but McKittrick in Kern County is a nearer railroad point to this section. Steamer service is available at Port San Luis. This harbor is the terminous of pipe lines from the San Joaquin Valley oil fields and is an important loading point for oil tankers.

Topography.

The Coast Range mountain system traverses the county from northwest to southeast. Within the county this mountain block consists of three main ranges. The Santa Lucia Mountains, the central and most prominent range divide the county into two unequal provinces, the larger lying north and east of this barrier and the smaller south and west of it. The southwestern area is again divided into Los Osos, San Luis, Arroyo Grande and Santa Maria valleys by lesser ridges, of which the San Luis Range, which terminates on the coast at Point Buchon and runs a little south of east until it unites with the Santa Lucia, is the most elevated. Northeast of the main Santa Lucia Range lies the upper Salinas River basin and numerous smaller valleys. The broad San Jose Range, including the La Panza Mountains and numerous spurs, occupies the area east of Salinas River. Near the source of the river this range unites with the Santa Lucia. Between these mountains and the Temblor Range in the southeast, which roughly forms the eastern boundary of the county, is the peculiar fault valley known as Carrizo Plain. This valley has no outlet, its scanty run-off draining to the center where Soda Lake has formed.

Geology.

The geology of that portion of the county from the southern boundary to latitude 35° 30′ N. and from the coast to longitude 120° 30′ W. has been described and mapped in detail by H. W. Fairbanks.[1] A discussion of the geology of the county with relation to petroleum resources will be found in Bulletins No. 69 and No. 89 of the State Mining Bureau. A folio of geologic maps accompanies Bulletin No. 69.

As indicated on the Bureau's geological map of the state, the Santa Lucia Range from San Luis Obispo northwestward to the northern boundary line is made up of Franciscan rocks, including slates, cherts, limestones, and sandstones, with much serpentine and many dikes and intrusions of deep-seated igneous rocks. On the flanks of the range are narrow belts of Cretaceous sandstones and shales. Southeast of San Luis Obispo the formations are mainly Tertiary marine sandstones and diatomaceous shales. Unconsolidated sands, gravels, and clays extend from Pismo to Santa Maria River and well up the valley of the Santa Maria. East of Santa Margarita there is a large area in which granite predominates. The balance of the county lying east and north of the Santa Lucia Range consists almost entirely of sedimentary rocks of Tertiary age, shales, sandstones, tuffs, and gravels with an area of Quaternary sediments comprising Carrizo Plain.

MINERAL RESOURCES.

A varied production of mineral products over a period of more than 75 years, whose value has run into the millions of dollars, has established this county as an important though not spectacular mining district. Both metallic ores and nonmetallic substances are widely distributed throughout the county, but their full extent and ultimate value is unknown due to lack of development. The county is known mainly for its production of quicksilver and chromite.

Gold in limited amount has been produced since an early date. Copper minerals are not uncommon throughout the Santa Lucia Range, but important deposits of commercial ores have not been developed. Antimony and manganese occur, and there has been some production of the latter. Platinum is a constituent of the black sands of the coast. Recent development has shown the iron ore deposits near San Luis Obispo to be of such extent and quality as to make them a factor to be seriously considered in any investigation regarding the establishment of an iron and steel industry in this state.

---

[1] Fairbanks, H. W., U. S. Geological Survey, San Luis Folio, No. 101.

In the south and southwest there are extensve deposits of bituminous sandstone, probably the largest in the state. The Arroyo Grande oil field produces some low-gravity petroleum. Hot and cold mineral springs and wells are found in various parts, especially in the vicinity of Paso Robles. Many varieties of stone, suitable for building purposes, are found here, including volcanic tuff, sandstone, granite, and onyx marble. These have been utilized to some extent. Bricks have been manufactured in considerable quantity. There are extensive deposits of diatomaceous earth and volcanic ash. Limestone and dolomite occur in quantity. Soda (salt cake) is produced at Soda Lake. Other nonmetallics, whose occurrence have been reported, are gypsum, magnesite, tourmaline and glass sand.

About twelve other mineral species, whose occurrence is of scientific interest only, have been found in the county.

The last general report on the mining industry is contained in Report XV of the State Mineralogist, 1915–1916. The quicksilver mines are described in detail in Bulletin No. 78, 'Quicksilver Resources of California,' 1918. Bulletin No. 76, 'Manganese and Chromium in California,' 1918, covers deposits in this county, as of that date. A discussion of the petroleum resources and possibilities of this area will be found in Bulletin No. 69, 1914, (out of print) and in Bulletin No. 89, 1921, (out of print).

The writer spent two weeks of September, 1925, in a resurvey of the mineral deposits of the county and gathering data relative to new developments and the present status of the industry. The assistance rendered by mine owners, operators and Chamber of Commerce officials is gratefully acknowledged.

Some data from earlier reports are included herein, but only brief mention will be made of properties (particularly quicksilver and chrome mines) covered in the special bulletins mentioned above, that are still in print. The petroleum industry is important, but distinct from other branches of mining, and it will be only touched upon.

In 1924 San Luis Obispo County produced eight mineral substances, valued at $317,779, as compared with an output valued at $145,249 in 1923. The banner year was during the 'war period,' in 1918, when the value of the county's mineral output totaled $858,689.

The following table gives the total recorded output from the earliest year for which figures are available to and including 1924:

SAN LUIS OBISPO

Year	Bituminous rock		Brick		Chromite		Gold, value	Mineral water	
	Tons	Value	M.	Value	Tons*	Value		Gallons	Value
1876[3]									
1877									
1878									
1879									
1880					[2]17,030	$184,704			
1881					1,790	24,000			
1882							$5,000		
1883					5,558	99,200			
1884									
1885					670	8,880			
1886					980	13,140	9,164		
1887	36,000	$180,000			600	7,980	1,740		
1888	43,000	215,000			300	2,550	3,000		
1889					4,300	66,865	6,260		
1890					687	5,496	8,800		
1891					74	592	1,785		
1892							1,097		
1893							600		
1894	9,432	32,263			[4]800	10,500	1,200		
1895	6,354	17,600	750	$3,750	[4]700	6,650	3,000		
1896	5,113	11,464			[4]200	2,000	3,000		
1897	2,291	5,117					2,500	7,800	$1,960
1898	4,788	18,927	830	5,280			1,000	800	400
1899	10,818	40,288	650	3,500					
1900	3,346	12,905	500	4,000					
1901	9,472	33,070	650	5,200			300	24,000	6,000
1902	1,790	2,327	900	7,650			2,399	4,500	900
1903	3,365	[illegible]	750	6,000			1,840		
1904							630	4,000	1,000
1905	2,533	6,348	400	3,200			300		
1906	2,533	6,644	300	2,400					
1907	2,167	8,128	2,000	16,000			316	4,800	1,000
1908	5,077	21,875	1,440	12,900				4,800	1,056
1909	2,731	6,369	2,245	19,605				4,000	1,000
1910	1,982	4,016	900	8,000				6,000	1,600
1911	2,710	5,230	2,000	18,000				2,000	1,000
1912	807	1,472						2,500	625
1913	609	1,149	1,750	17,500			124	1,500	600
1914	579	1,118						1,000	250
1915	[6]				[6]			4,500	675
1916	[6]		4,150	45,500	1,855	27,733		2,500	475
1917	[6]		[6]		4,109	92,846		1,500	300
1918	[6]				10,443	539,423	[6]	[6]	
1919	[6]				1,158	26,431			
1920					[illegible]	[illegible]			
1921					[6]				
1922									
1923									
1924			2,033	35,987					
Totals	[6]157,497	$638,882	[6]22,248	$214,472	[6]51,653	$1,129,430	[6]$54,055	[6]76,200	$18,741

---

*Copper was weighed in tons of 2,360 pounds and chromite in tons of 2,240 pounds, but here converted to 2,000 pounds.

[1] The total production of asphaltum up to 1894 was reported as 800 barrels. This production reduced to tons is shown under 1894.

[2] Although a great deal of chromic iron ore was mined and marketed during the '70's, there are no records of yearly production. The above figure for 1880 represents the total shipments from San Luis Obispo up to August, 1880.

[3] There are no records of annual mineral production for the period of 1865-1876, but there was a small annual gold production from shallow placers before this, and these placers have no doubt yielded considerable gold never reported. The same observation applies to a number of small quicksilver properties worked in the '70's.

[4] Concentrates.

[5] Includes crushed rock, rubble, sand, gravel; also granite and sandstone prior to 1915

[6] See under 'Unapportioned'.

COUNTY, 1876-1924.

Petroleum		Quicksilver		Miscellaneous stone[5], value	Miscellaneous and unapportioned		
Barrels	Value	Flasks	Value		Amount	Value	Substance
		6,428	$282,832		*236,000 lbs.	$7,287	Copper.
		3,310	123,463				
		2,151	70,768				
		779	2,358				
				$8,772	[1]220 tons 500 cu. ft.	4,400 20,000	Asphaltum (rock). Cal. onyx.
		20	800	45,520	400 cu. ft.	4,000	Cal. onyx.
		101	3,400	17,407			
		101	3,939	13,500	238 cu. ft.	1,000	Cal. onyx.
		384	11,660	47,000			
		394	17,700	6,740	16 tons	320	Asphaltum (rock).
		515	23,886	44,835			
		840	41,513		2,000 tons	30,000	Asphaltum (rock).
		3,312	147,215		4,000 tons	40,000	Asphaltum (rock).
		4,577	183,530	58,374	100 bbls.	100	Lime.
		4,746	176,616	81,000			
		3,733	133,748	46,000			
		3,511	128,152	35,500			
48,127	$16,845	2,509	95,743	3,000	6,000 tons 300 bbls.	90,000 600	Asphaltum (rock). Lime.
10,000	5,000	867	36,648	900			
30,000	15,000	317	15,510	400	4,500 tons	55,000 218,205	Asphaltum (rock). Unapportioned, 1900-1909
22,310	11,155	563	25,476	75	13,000 tons	165,000	Asphaltum (rock).
38,092	25,146	569	26,180				
2,129	1,469	666	27,998				
		1,160	46,667	134			
		1,266	62,097				
		1,473	125,542	99,475		1,940	Bituminous rock, chromite.
11,670	5,252	1,227	114,724	49,318	356 lbs.	88 2,717	Copper. Bituminous rock, pottery clay, sandstone.
74,143	68,656	1,565	151,034	8,422		16,886	Bituminous rock, brick, manganese, soda.
62,744	56,783	[6]		6,100	1,907 tons	81,926 174,447	Manganese ore. Bituminous rock, copper, gold, mineral water, quicksilver, silver, soda.
31,656	32,922	[6]		20,300		132,777	Bituminous rock, manganese, quicksilver, sandstone, soda.
42,511	59,515	1,224	89,186	[6]		246,463	Copper, granite, manganese, soda, miscellaneous stone.
30,725	43,691			80,000		6,100	Chromite, diatomaceous earth, mineral water.
33,856	31,892			107,000		2,578	Chromite, diatomaceous earth, mineral water.
32,988	19,793			46,479		78,977	Chromite, diatomaceous earth, mineral water, quicksilver, soda (salt cake).
31,222	30,972	[6]		113,384		137,436	Mineral water, natural gas, quicksilver, sodium sulphate.
466,173	$424,091	[6]48,308	$2,168,385	$939,635		$1,518,307	

ANTIMONY.

Stibnite, the common ore of antimony, occurs near the head of San Simeon Creek and on its south fork near the summit of the Santa Lucia Range. The deposits are of doubtful commercial value.

Marquat Estate Deposit. A quartzitic vein, three feet in width with about one foot of stibnite on the footwall, has been uncovered on this property. The vein is in Franciscan sandstone. It strikes NE. and dips 70° NW. One shipment of ore was made years ago and a little prospecting was done at this locality during the war period, but nothing recently. Owned by the Marquat Estate, Mrs. Bena Marquat, administratrix, San Luis Obispo.

Bibl: State Mineralogist's Report X, p. 579; XV, p. 676. State Min. Bur. Bull. 91, p. 29.

ASBESTOS.

Asbestos of uncertain quality and in unknown amount occurs in the mountains between Poso and Hasbroucks. It is said that a shipment was made from here a number of years ago, but the fiber was of such short length that the product did not bring a profitable return. This is the only deposit of asbestos of record in the county. The locality was not visited.

ASPHALT.

Natural asphalt was formerly used a good deal in this state for paving, and San Luis Obispo was a considerable producer of it. Of late years, however, the natural product has been displaced by the material yielded in crude oil distillation, as the latter is more uniform in quality and more cheaply obtained.

The principal natural deposits were on Tar Spring Creek, 9 miles east of Arroyo Grande, and in the bituminous rock area near Edna. There has been no output of natural asphalt from either locality for many years.

Bibl: State Mineralogist's Reports VII, p. 97; XII, p. 30; XV, p. 676. U. S. Geol. Survey XXII Annual Report, Part I, p. 412; Mineral Resources 1883–84.

BITUMINOUS ROCK.

Sands of the Pismo and Santa Margarita formations which have been saturated with and cemented together by natural asphalt, are of widespread occurrence in San Luis Obispo County. The asphalt comes from the underlying Monterey shales and when it seeps up into the overlying sand it changes the latter into a tough weather-resisting stratum.

The deposits have been most extensively developed near Edna, a station on the Southern Pacific railroad about six miles south of San Luis Obispo. Other quarries have been opened along and near San Luis Bay; near the town of Arroyo Grande, and on Tar Spring Creek, 9 miles east of Arroyo Grande, where natural asphalt was also refined years ago.

With one exception all the quarries that were formerly worked have been idle for many years.

Consolidated Bituminous Rock Co. This company owns a large tract of land one mile southwest of Edna, about 40 acres of which contains workable deposits of bituminous sandstone. It was worked at irregular intervals for a number of years, but has been idle since 1920.

J. F. Beckett, of Arroyo Grande, has a deposit but has made no production.

> Bibl: State Mineralogist's Reports VII, pp. 53, 97–99; VIII, p. 533; X, p. 571; XII, p. 29; XIII, p. 37; XV, pp. 83–85. U. S. Geol. Survey San Luis Folio 101.

BRICK AND CLAY.[1]

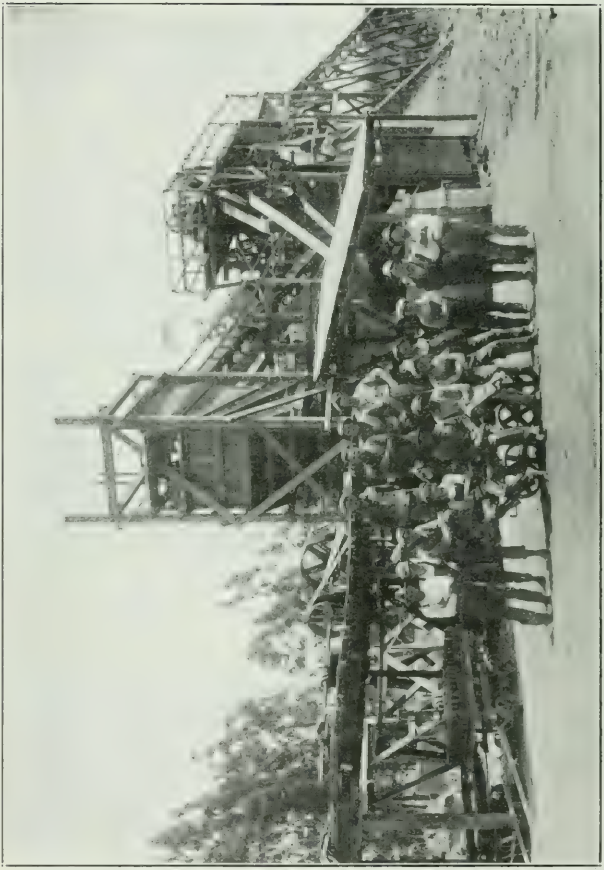
There are no known deposits of high-grade clays in this county, but red-burning clays suitable for making brick occur in the valley silts of recent origin at various places. Since the population of the county is small, the demand for clay products is limited, and a single common brick plant at San Luis Obispo supplies the market of the county, as well as of a few nearby towns in Santa Barbara and Monterey counties. The territory to the south is supplied by brick yards in Santa Barbara, while plants in Gilroy and San Jose furnish brick for the communities in Monterey and San Benito counties.

San Luis Brick Works (formerly *San Luis Brick Co.*). This property is owned and operated by Faulstich Bros., San Luis Obispo. The plant is located one mile south of town near the lines of the Southern Pacific and Pacific Coast railroads. The clay used is a yellowish loam, with little or no overburden. The proportion of sand is sufficient to prevent excessive shrinkage and cracking in the brick-making process, yet is not so high as to interfere with the binding properties of the clay. The clay is mined to a depth of 15 feet by hand shoveling into dump cars, which are hauled up an incline by a steam-winch, and dumped through a hopper into a 10-foot dry pan. After screening, the fines pass to a pug mill, then to an American Clay Machinery Co.'s auger machine equipped with a Freize cutter. The oversize from the screen is returned to the dry pan.

The brick are dried in the open without auxiliary heat; this requires an average of three weeks. Burning is done in open field kilns, usually with 18 arches, each kiln containing 590,000 brick. Heat is supplied by oil, with steam atomization. Firing requires five days, and cooling about three weeks. The plant operated three months during the season of 1925, producing about 1,500,000 brick. Twenty-eight men are employed when in full operation.

---

[1] From notes supplied by W. F. Dietrich, who is preparing a report on the clay resources of California for the State Mining Bureau.



Plant of San Luis Brick Works, San Luis Obispo. Photo by courtesy of the company.

CHROMITE.

Chromic iron ore has been one of the staple mineral products of this county since the seventies. The output has varied, however, in accordance with the market demand and price, ceasing altogether between 1896 and 1914. During the emergency created by the World War, mining was resumed on an enlarged scale, more than 10,000 tons being produced in 1918. At the ending of hostilities in the latter part of 1918, the market collapsed and chrome mining practically ceased. The development work which had been carried on, however, resulted in the opening up of ore reserves sufficient to supply the present Pacific coast requirements for many years.

Previous reports still available describe the mines and prospects in detail. These detailed descriptions will not be repeated herein, the following supplementary notes being intended to show the present status of the properties only. Those properties which were located as mining claims on public land are, with a few exceptions where assessment work has been kept up, abandoned. Deposits on privately owned lands that were worked under lease almost without exception have reverted to their owners and are idle. At one or two mines a little development work has been carried on and a small production made.

Alvisa and Sunshine Claims. Located in Sec. 34, T. 29 S., R. 12 E. Abandoned.

Castro Mine. This mine is situated in the east half of Sec. 29, T. 29 S., R. 12 E. It was equipped with a 50-ton concentrating mill and has been a large producer. Operated during the war period by the California Chrome Co. The property is patented. Owned by Alfred A. Wheeler, 1640 Clay street, San Francisco. Idle.

Chorro Creek Mine. Located in Sec. 34, T. 29 S., R. 12 E. Abandoned.

Colorado Chrome Mine. Located in Sec. 32, T. 29 S., R. 12 E. Abandoned.

Cypress Chrome Mine. In Sec. 34, T. 29 S., R. 12 E., adjoining the Chorro Creek. Abandoned.

El Divisadero Chrome Mine. This property is in Sec. 33, T. 29 S., R. 12 E. It is patented and owned by L. H. Butcher Co., 274 Brannan street, San Francisco. Idle.

El Salto Chrome Mine. Situated on the west half of Sec. 33, T. 29 S., R. 12 E. Patented land. Owned by L. H. Butcher Co., 274 Brannan street, San Francisco. Idle.

Evans Ranch Deposit. In Sec. 2, T. 25 S., R. 6 E., on W. J. Evans Ranch. Idle.

Froom (Mrs.) Ranch Deposit. Situated in Sec. 8, T. 31 S., R. 12 E., on Laguna Rancho Grant. Idle.

Johe Ranch Deposit. Located in Sec. 2, T. 31 S., R. 11 E. This property is now a part of the holdings controlled by McKinney Iron Mines. Idle.

La Primca and *La Trinidad Chrome Mines.* Property consists of 180 acres of patented land in Sec. 33, T. 29 S., R. 12 E. These mines were good producers. Owned by L. H. Butcher Co., 274 Brannan street, San Francisco. Idle.

Lucky Jack Group. This group is in Secs. 29 and 31, T. 29 S., R. 12 E. All claims, except the Lucky Chrome upon which assessment work is kept up, have been abandoned. Production has been about 45 tons. Owner, W. M. Duff, San Luis Obispo.

Middlemast Chrome Deposit. On the W. C. Middlemast Ranch in Sec. 25, T. 28 S., R. 10 E. Idle.

Mutual Chrome Mine. Comprised 80 acres in Sec. 35, T. 29 S., R. 12 E. Abandoned.

London Chrome Mine. This property produced about 3500 tons of ore when last operated during the war period. Development work carried on before the collapse of the chrome market in 1918 revealed extensive reserves of ore which have not as yet been mined. The map herewith shows the underground workings and orebodies developed. Owners, W. C. H. Dibblee and P. A. H. Arata of San Luis Obispo. Idle.

Norcross Chrome Mine. Situated in Sec. 13, T. 29 S., R. 11 E. This mine was under lease to the Union Chrome Co., of San Francisco, during the war period. A mill was erected and a fair tonnage of concentrates averaging 44% Cr_2O_3 was made. Idle and probably abondoned.

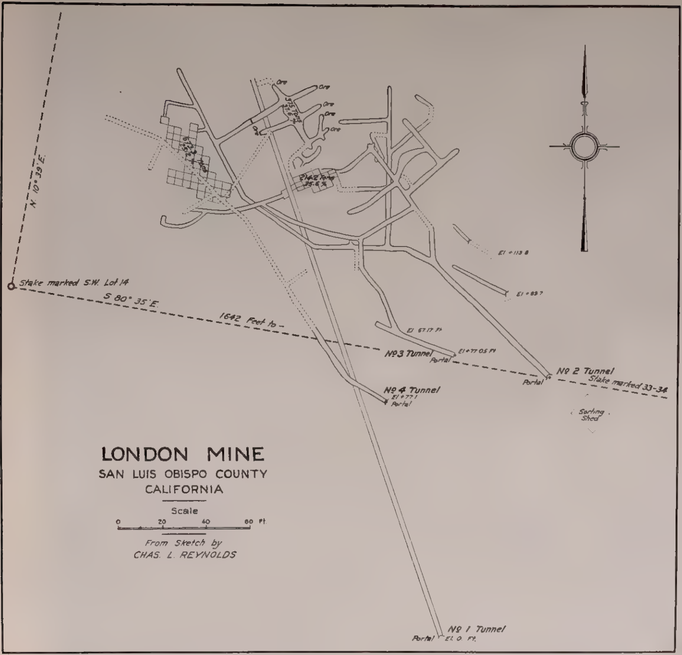
Pick and Shovel Mine (also called *Safety Chrome Mine*). This property comprises 83.2 acres in the SE¼ of Sec. 34, and the SW¼ of Sec. 35, T. 29 E., R. 12 E. It was worked more extensively in the early days than any other chrome deposit in the district and produced a large tonnage between 1880 and 1890. Many of the old workings were caved, but the mine was reopened when the acute demand for chromite was created during the war, and over 4000 tons of high-grade ore have since been produced. Extensive development work uncovered large reserves which were not drawn upon before the ending of hostilities. The limited tonnage of domestic chromite consumed on the Pacific coast since the war period has come mainly from this property, and the owner is prepared to contract delivery of any required tonnage. The Pick and Shovel is the only producing mine in the county at the present time, one or two men being engaged in doing additional development and mining. The workings are shown on the accompanying map. Owner, P. A. H. Arata, San Luis Obispo.

Pine Mountain Group. The claims are in Secs. 3 and 10, T. 26 S., R. 8 E. About 400 tons of good chromite was produced here in the eighties. The group is now a part of the Wm. R. Hearst Ranch holdings, having been purchased by the Hearst interests.

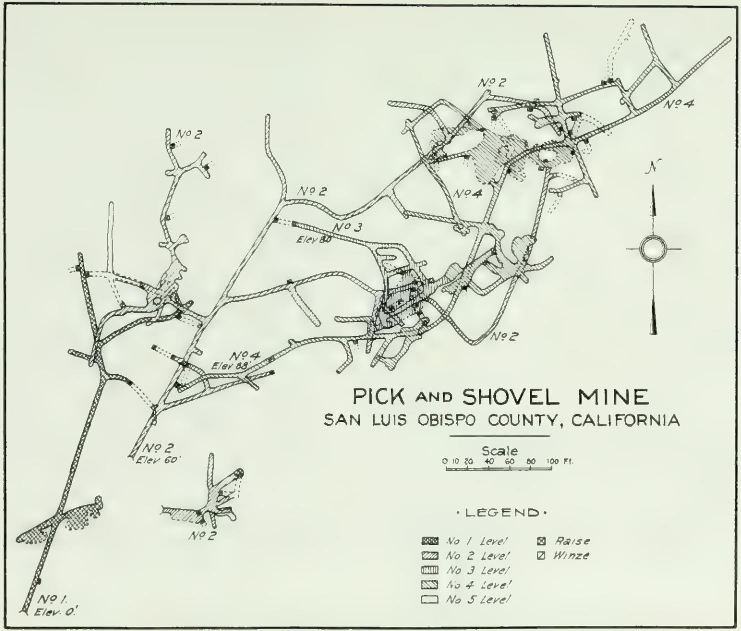
Pereira Group. This group comprised three claims, located in 1918, in T. 25 S., R. 8 E. They were soon after sold and are now a part of the large land holdings of Wm. R. Hearst.

Rancho Piedra Blanca. Undeveloped deposits occur on this property, owned by Wm. R. Hearst. They are on Sec. 4, T. 25 S., R. 7 E.

Rancho Santa Manuela. Chromite has been found on this property, six miles northeast of Arroyo Grande.



Map of London Mine workings, San Luis Obispo County.



Map of Pick and Shovel Mine workings, San Luis Obispo County.

Rancho Santa Rita. Some chromite was shipped from here in the eighties. It is eight miles northeast of Cayucos.

Russ Deposit. A small deposit was opened up on this ranch in Sec. 4, T. 25 S., R. 6 E. Antone D. Russ, owner. Idle.

San Bernardino Creek Deposit. E. L. Ellberg, of San Luis Obispo, and H. L. Flournoy, of Morro, have made a small production of chrome ore from deposits near the headwaters of San Bernardino Creek in T. 29 S., R. 11 E.

San Carpojaro Creek and *Arroyo La Cruz Deposits.* These two claims were located in Sec. 12, T. 25 S., R. 7 E. An orebody about five feet wide was exposed here, but the locality is almost inaccessible. Probably abondoned.

Sweetwater Chrome Mine. This property is in Sec. 12, T. 29 S., R. 11 E. It was a good producer of high-grade ore. W. W. Pierce et al., of Morro, owners. Idle.

Welsh Ranch Deposit. A small lens of chromite was uncovered here in Sec. 4, T. 31 S., R. 11 E. Idle.

Zerfing Ranch Deposit. This deposit is located on the property of Arthur L. Zerfing of Cayucos. The best ore was in the SE¼, Sec. 24, T. 28 S., R. 10 E. Idle.

Bibl: U. S. Geol. Surv. Bull. 430, pp. 168–173, 181–182; San Luis Folio 101. State Mineralogist's Report XV, pp. 674–726. State Mining Bur. Bull. 76, pp. 167–178.

COAL.

"In the spring of 1847, a new coal mine was discovered near San Luis Obisco, north latitude 35°. There are now three mines within three hundred miles of Monterey; yet coal was sold, in 1846, from an American whaler, at $5 a bushel."[1]

Coal was found on the beach at San Simeon in the sixties and the San Simeon Coal Mining Co., said to have been the first mining company started in the county, was soon after organized. The outcrop of the vein was two feet in width and usually covered with water at high tide. A shaft was sunk to a depth of 100 feet, at which point the vein had dwindled to a mere seam and mining was abandoned.

A small seam, not over 15 inches thick, occurs on Pico Creek, about four miles from the beach, on the Piedra Blanca Grant.

Coal is also reported to have been found between Poso and Hasbroucks. It is probable that this and the other deposits mentioned are too small to invite exploitation.

Bibl: State Mineralogist's Reports VI, p. 118; VIII, p. 532; XII, p. 61.

COPPER.

A few small bodies of high-grade copper ore and surface indications of more extensive deposits of low-grade orebodies have been noted at various places throughout the serpentine areas in this county. Many prospects were located in the sixties, and a few shipments of copper ore were made in the early days to Swansea, Wales. These ores usually carried some gold and silver values as well. The most commonly occurring copper minerals are chalcopyrite and malachite, with occasionally native copper disseminated through the serpentine.

---

[1] Taylor, R. C., Statistics of Coal, Second Edition, Philadelphia, 1854.

Some ten or twelve copper properties have been described by name in Bulletin No. 50, 'Copper Resources of California,' 1908, and in State Mineralogist's Report XV, 1915–1916. Most of these properties are quite inaccessible, and at the present time there is no activity at any of them. It does not appear likely that there will be an appreciable production of copper from the county in the near future, although the cupriferous belt of the Coast Range is more worthy of attention here than at any other point between its southern end and San Francisco Bay.

The principal mineralization is in the Santa Lucia Range, north and northwest of San Luis Obispo and in Los Osos Hills. Owing to abandonments, changes in names and ownerships, relocations and long periods of idleness, it is difficult to give any connected history of the copper properties.

Los Osos Mine. This deposit was located in 1864. The vein, 4 to 12 feet in width, was developed by a shaft 230 feet deep. One hundred tons of 18% copper ore was shipped to Swansea, Wales, in early days. The workings have been caved for years. The deposit is on property now included in the holdings of McKinney Iron Mines. It is designated on the map of the latter (see page 518, *post*) as the Goodwill Copper Mine. There is a possibility that this property may be reopened.

Bibl: State Mineralogist's Report XV, p. 686; State Min. Bur. Bull. 50, pp. 172–173.

The *Guerro*, *Guadalupe*, *Gloria*, *Tassajara* and *Tiptop* claims were all locations in T. 29 S., R. 12 E. on copper showings. They are probably all abandoned, as little or no work was done on them.

W. K. Hobson has eight claims between Morro and Toro creeks, eight miles due east of Cayucos.

Refugio claim was located on Chorro Creek, seven miles north of San Luis Obispo. There is reported to be a 4-foot vein carrying native copper and sulphides on this property.

Bibl: State Min. Bur. Bull. 50, pp. 172–174.

Prodical Son. This claim was located six miles east of Cayucos, between Toro and Old creeks. The ledge carried chalcopyrite, gold and silver, and was opened by a 50-foot shaft.

Bibl: State Min. Bur. Bull. 50, p. 173.

Schneider and McCles Claim was on San Bernardo Creek, seven miles east of Morro.

Bibl: State Min. Bur. Bull. 50, p. 173.

Silver Swan Mine, embraces two claims, owned by R. D. Hazzard, of Cayucos, and located eight miles east of Cayucos, near the headwaters of Morro and Toro creeks. There is a 300-foot tunnel on the property. It is said to have produced some copper.

Bibl: State Mineralogist's Report XV, p. 686.

Sky Scraper. This claim is in the same vicinity as the Silver Swan. It was developed by two tunnels which tapped a vein about 10 feet wide carrying chalcopyrite. Wm. Drought, Cayucos, last known owner.

Bibl: State Mineralogist's Report XV, p. 686; State Min. Bur. Bull. 50, p. 173.

Take-a-Chance Group, included 30 claims owned by James Wheeler et al., of Santa Margarita, covering copper showings in the form of native copper, malachite and chalcopyrite, in a belt near the summit of the Santa Lucia Range, four to seven miles south and west of Santa Margarita at an elevation of 1500 to 2000 feet. This group included a number of former claims that had been abandoned. It is understood that some of these claims are still held by the locators.

Bibl: State Mineralogist's Report XV, p. 686.

DIATOMACEOUS EARTH.

White, chalk-like beds of diatomaceous or infusorial earth are associated with other Tertiary sedimentary formations over an extensive area in the Coast Range.

The belt running through the southern part of Monterey County continues south into San Luis Obispo. Many detached exposures of diatomaceous earth have been noted here, but they have only been utilized to a limited extent up to the present time.

A deposit in Sec. 23, T. 26 S., R.10 E., near Adelaide, was worked for a time in 1880, the material being sold as 'Magic Polish.' The bed here is reported to be six feet thick and to cover 25 acres.

Undeveloped deposits occur about three miles north of Arroyo Grande, close to the Pacific Coast Railroad and in Verde Canyon.

A bed is exposed close to the Southern Pacific Railroad, opposite Edna.

Other deposits have been noted in the mountains back of Pismo and at various points along Salinas Valley as far south as Rinconada Valley.

An undeveloped deposit of diatomaceous earth is reported to occur on Lots 13, 15, 16 and 17, of San Miguelito Rancho lying south of San Luis Obispo.

Ferrell Deposit. There is a deposit of diatomaceous earth owned by C. E. Ferrell, P. O. Box 156, San Luis Obispo, on Los Osos Creek south of Morro Bay. The bed here is 45 feet in thickness. It is a continuation of that on the property of the Incello Company. There is a good road from the deposit to San Luis Obispo, a distance of 11 miles.

Hazzard Gragg Deposit. A deposit of cream-colored diatomaceous earth has been opened up by a 90-foot tunnel on the Rancho San Miguelito. The deposit is on a tract of 168 acres, owned by Hazzard Gragg. It is on the coast highway, 2 miles south of Avalon. There has been no commercial production to date.

Incello Company, The. This company controls about 1000 acres of land, formerly a part of Cañada de Los Osos Grant, on which there is a large deposit of diatomaceous earth. The deposit is on the south side of Los Osos Valley, about two miles south of Morro Bay and ten miles west of San Luis Obispo, the nearest railroad shipping point. The company also has a plant adjacent to the Southern Pacific and Pacific Coast Railroad lines, near the end of Broad Street, San Luis Obispo, for the manufacture of insulating brick.

The Incello Company was organized about three years ago, absorbing the U. S. Refractories Co., which had made a small production before the reorganization. The present company has not been fully financed, and the plant has not been in operation recently. Robert W. Hull is president, and N. J. Shields, secretary; home office, San Luis Obispo.

The deposit of diatomaceous earth controlled by the company outcrops at an elevation of 250 feet. An excellent gravelled highway through Los Osos Valley extends to within a half mile of it. From the highway to the loading bunkers there is a planked road over low sand dunes which intervene. A Clyde hoist is housed above the bunkers, and a tramway extends from here to the quarry face at the bottom and on the opposite side of a small gulch. The tramway has a slope of approximately 30° and a length of about 400 feet. The strike of the bed where mined is northwest and it dips 45° southwest into the hill. An adit 60 feet in length run as a cross-cut is entirely in the white diatomaceous earth. Other development consists of numerous test pits and trenches on both sides of the gulch.

The brick plant is equipped with a Williams hammer mill, dry pan, pug mill, Fernholtz-Formo press, dryer, cars, etc. For burning, there are two round 30-foot bee-hive type down-draft kilns holding 80,000 brick, and two smaller experimental kilns. Each unit is equipped with individual motors for electric power operation. The plant has a capacity of 10,000 brick per day. It is uncertain when the company will again be in production.

Pismo Heights Company. This company has a deposit of diatomaceous earth on their property, one-half mile north of Pismo between the State Highway and the Southern Pacific Railroad. It is undeveloped. W. E. Wolfe, manager, Pismo, California.

DOLOMITE.

There is a deposit of white dolomite in Sec. 13, T. 30 S., R. 13 E., at the upper end of Little Falls Canyon, a branch of Lopez Canyon.

S. Aumaier, 1127 Monterey Street, San Luis Obispo, and *Peter Roderjuez* have located one claim here. It is accessible by trail only, as the nearest roads terminate several miles from the deposit. A sample analyzed by Smith, Emery and Co., of San Francisco, gave the following results:

SiO_2	0.40%
Al_2O_3	0.19
Fe_2O_3	0.05
CaO	31.70
MgO	20.44
Loss on ignition	47.36
	100.14

GOLD.

San Luis Obispo can scarcely be considered as one of the gold producing counties of the State, although gold was probably mined here before 1848. There is no record of the output previous to 1882, but it is thought that it amounted to at least $100,000, as several hundred men were working for a time. Most of the metal has been obtained by ground sluicing and panning. The Franciscan metamorphics of the Santa Lucia range have fed a little gold into the streams on both sides of this range. San Marcos creek, west of Paso Robles, was worked, as well as a number of streams on the west slope. The Nacimiento River is being prospected just below the mouth of Las Tablas Creek at the present time. The best known and most important placers, however, have been in the gulches heading in the granitic area of the San Jose range in the vicinity of La Panza and Pozo. Some work is going on in this section at the present time, and there is probably a small annual output, although it may not always become of record. There are no quartz mines in the county. A 10-stamp mill was erected by the Cuesta Gold Mining and Milling Co. at a property a few miles northwest of San Luis Obispo, about 15 years ago, but it was only operated a short time. After doing some work which failed to develop ore, the mine was abandoned and the mill dismantled in 1913.

Morning Star Placer Mining Co. This company is out of existence, and its claims in Secs. 6, 7, 8, 17, 18, 19 and 20, of T. 30 S., R. 17 E., have been abandoned. Sixty acres on San Lorenzo Creek, formerly a part of their ground, has been taken up by T. H. Williams, J. W. Monell, and Mrs. Martha Williams, who work it by ground sluicing when water is available.

Navajo Mines. This property is on Navajo Creek. Owner, Bert Alley, Pozo, California. There is considerable ground here which the owners claim will run 50¢ per yard and could be dredged. A home-made placer machine, run by a gasoline engine, is being used by the owner, who has been operating quite steadily.

Queen Bee Mine. Owner, Henry Chester, 5701 York Blvd., Los Angeles, or Pozo, California. This property comprises approximately 200 acres on Mineral Creek, which have been held by the present owner since 1896. The deposit is composed of uncemented gravel of medium size with an average depth of 12 feet. The bedrock is granite. It has been worked to a considerable extent by ground sluicing. Values occur from the surface down and are fairly evenly distributed. The gold is coarse and somewhat rough, running from 25c pieces up, with occasional nuggets worth $5 to $6. It is said to be very high grade, assaying $19.65 to $19.75 per ounce, and is sought by jewelers and dentists on account of its easy working qualities and purity. Most of the production has been sold to such buyers. The property has been recently examined by Los Angeles parties who contemplate putting on a machine capable of handling the gravel on a fairly large scale. An additional water supply is being developed, and the owner is also doing a little work on a 3-foot quartz vein found here, which shows low values. The recent dry season has curtailed sluicing operations.

Still Ranch Property. Owner, O. S. Still, La Panza, California. This property is in T. 29 S., R. 16 E. About 400 acres in Sec. 30 is considered to be mining ground. The elder Mr. Still came into the region over 45 years ago and engaged in placer mining with several hundred other Americans, Mexicans and Chinese. As the richer surface placers were worked out and abandoned the present owner acquired the ground, which now has become a part of the ranch. For 35 years past but little attempt has been made to mine it, although some gold has been recovered with rockers by prospectors and itinerant miners, who were seeking a grubstake. Water for working has been limited in recent years.

A Pierce gold-saving machine, constructed and owned by R. A. Pierce, Morro Bay, is on the property, but was not in operation when visited. Similar machines have been installed by Mr. Pierce at several other localities in central and northern California.

GYPSUM.

No deposits of gypsum of economic importance have as yet been developed. It occurs, however, in limited quantity as white bunches and veins on Alamo Creek, 16 miles from Santa Maria, and in the form of alabaster at Arroyo Grande. Gypsite, an impure form, is found in beds on the southwest side of the Temblor Range, east of Carrizo Plain, and crystals of selenite occur in the clays along Carrizo Creek.

Bibl: State Mining Bur. Bull. 91, p. 271.

IRON.

Iron ore represented principally by an extensive deposit in the Los Osos hills, five miles west of San Luis Obispo, is one of the most important latent mineral resources of the county.

Diverse ownerships and interests have heretofore prevented this entire field being considered as a unit, and it has not attracted the attention which its favorable location near tide water, extent and the character of the ore seemed to warrant. During 1924 the various interests were united, and the combined properties present a strong argument for the establishment of the initial plant of an iron and steel industry here; whether this takes the form of blast furnaces, some process using petroleum fuel in the direct reduction of iron, or a combination process using low-grade fuel, such as lignite or petroleum by-products, in the production of sponge-iron and electric melting of the sponge.

A process of the latter character, which eliminates entirely the need of coke and permits the direct production of steel from iron ore by the use of fuel oil and its by-products, has lately been developed by the Wakama Iron and Steel Co., a California corporation.

A great deal of experimental work has been carried on by this company and the process has been demonstrated under the supervision of Smith Emery and Company, Testing Engineers, at various commercial foundries in the San Francisco Bay district having electric furnaces. Pours of over a ton of metal have been made by the regular foundry crews from charges composed of ore reduced in retorts by this process. The analyses of the resulting steel and its physical properties have been attested by Smith Emery and Company.

The favorable results attained by the use of such available equipment seems to point to the unqualified metallurgical success of this method of producing steel in a plant primarily designed to use it.

This direct steel process, which was patented in the United States in 1920, and for which foreign patents are pending, is designed to produce steel directly from iron ore without the necessity of making pig iron as an intermediate step. It consists essentially in the reduction of the ore to iron sponge by the agency of ordinary carbonaceous fuels, and the melting of the sponge immediately on its formation, producing steel of a predetermined composition, the process being continuous. It differs from previously proposed methods in that the material is not allowed to cool from the beginning to the end of the operation; nor is the sponge exposed at any time to the oxidizing effect of the air or the furnace gases. The importance of excluding the air and steam from the heated sponge, which absorbs oxygen with the greatest avidity is well known. It is, in fact, this propensity which has heretofore rendered nugatory all attempts to manufacture solid iron from it.

In carrying out this process, pulverized iron ore is taken and thoroughly mixed with carbonaceous fuel, either liquid or solid, and placed within metallic retorts. Any fuel will answer, provided it will leave a residue of fixed carbon on heating. The value of the different fuels, as powdered coal and coke (screenings), charcoal, the residue of gas works and oil refineries, etc., has been determined on a working scale and as applied to the different ores of iron, and very interesting facts have been brought out. The proportion of fuel required varies inversely as its fixed carbon when applied to the reduction of magnetic ore, on which the volatile constituents seem to have little effect. But limonite, and to a less degree hematite, are amenable to the action of even quite volatile gases.

Having mixed the ore with the fuel, whose fixed carbon may average 20 per cent of the weight of the metallic iron in the ore, the mixture, to which the necessary fluxes are also added, is placed in the retort, which may be either spherical or cylindrical in order to roll, and charged into the cooler end of the furnace, in which it is brought to a bright red heat and kept so for some hours, during which the ore is deoxidized; the iron being left in a powdery condition or at the highest practical heat sintered into a porous mass about as coherent as a half-burnt brick.

The furnace in which the foregoing process is carried on is a very long reverberatory, similar to the heating furnaces used in rolling mills. It has preferably a sloping hearth to facilitate the travel of the shells (retorts) which cover its hearth and roll parallel to each other from the cold to the hot end. It is heated partly by an independent fire at the hot end, but mainly by the combustion of carbon monoxide. Thus, there is no loss of the fuel in this process, except by unavoidable radiation from the long furnace.

The reaction being complete, the ore thoroughly reduced and the shell with its contents at the highest permissible temperature, a door which separates the reducing furnace from a melting compartment is opened and the shell allowed to roll into the latter, where it with its contents is melted down, producing liquid steel.

By the integral construction of the two furnaces, making them practically one, and by other devices, the inventor has succeeded in making the process continuous, and to a certain degree automatic. There is no manual labor connected with the charging or discharging of the reduction furnace. As for the shells, they are cast from the molten metal from the melting furnace, and weigh about one-third as much as the iron they enclose. It should be mentioned that apertures are left in them for the escape of the gases, which would otherwise tend to rupture them. Experience shows that from six to eight hours' exposure to gradually increasing heat is required for the reduction of a shell holding 300 lb. of iron ore, the ore being magnetite.

There must be, therefore, a large number constantly under treatment, and in the projected works it is the intention to use furnaces having a capacity of 100 shells or more at any time. The shells lie parallel and in contact during their passage through the furnace, and receive the heat produced by the combustion of the gases which issue from their interior, as well as that due to the fire at the end of the furnace.

There is nothing novel about the melting compartment, a common open-hearth or electric furnace in which the steel collects and is duly tapped and poured out. It will be readily understood that the melting takes place rapidly, since the materials are already nearly at the fusing point when they enter the furnace, thus bringing about a considerable saving of time and fuel and preventing undue wear and tear. Attention is called to the difference between this and ordinary practice. In the new method the materials are charged hot and almost instantaneously; in the older they are charged cold and in installments, occupying often an hour or more for a single charge, during which time the side doors are open, causing great loss of time and heat. Further, the temperature of the interior oscillates with constant damage to brickwork. These drawbacks are avoided in the working of the new process, though it is fair to say that it is not intended to use the melting compartment for refining the steel. An auxiliary furnace will be used for that purpose, the metal being tapped into a ladle, transferred to the refining furnace, and there treated with the additions and brought to the proper composition and temperature for casting. It is evident that this work could not well be performed in the primary furnace, since the reduction furnace requires to be run at a regular pace in order to do its best work, and could not by any means be allowed to wait upon the melting department. It is considered that an allowance of one square foot of open-hearth area would suffice for the melting of one ton of steel in twenty-four hours under these conditions, but in order to meet the extra work imposed by the occasional presence of unreduced ferrous oxide in the retorts, this allowance will be increased to 1½ square feet.

The metal thus far in quantities up to a ton or two at a heat has proved fully equal in quality to corresponding grades of commercial steel and ranges in composition from soft steel of point 20, up to the hardest kind with one per cent, and even as high as pig iron with three or four per cent, therefore, it is easily controllable.

It appears that this invention is an important improvement on electric steel making, since it substitutes during the process of reduction the much cheaper heat of ordinary fuels for the costly heat of electric current, only employing the latter for the final melting. Thus, the consumption of current is brought down to less than one-fifth that heretofore employed. If to this consideration is added the superior control which is had over the composition of the product, it must be granted that the new process has a great field of future usefulness.

Claims covered by the letters patent are:

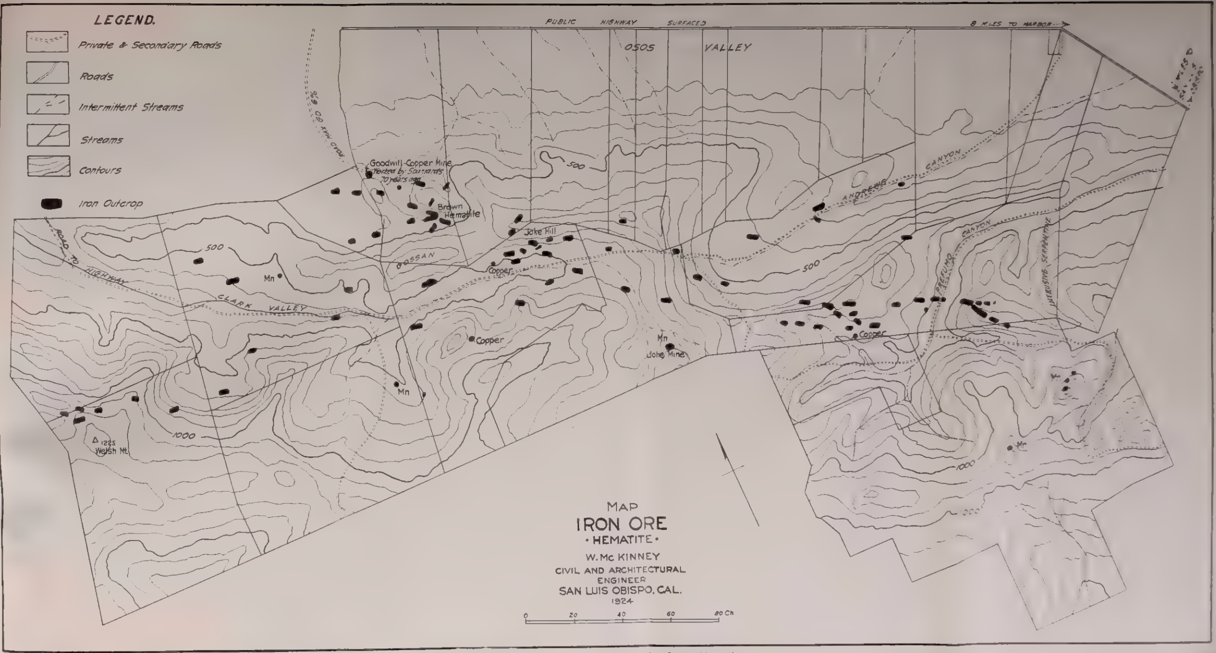
1. Reduction of the metal by means of the cheaper and more common sorts of combustibles.
2. The intermixture of the combustible with the ore previous to heating.
3. *The reduction inside of closed receptacles.*
4. The gradual heating through a considerable period of time.
5. The exposure, first, to very low temperature, followed by gradually increasing heat, by which fuel is saved and a more perfect reduction insured.
6. The use of *metal containers,* impermeable to gases, by which the reduced *iron is prevented from reverting to oxide.*
7. The circular form of container which admits of its being rolled forward in the furnace.
8. The automatic forward feed of the containers along the downwardly sloping furnace bed without labor or attention of any kind.

   The manufacture of the containers which will be carried on at the furnace side, by means of a semi-automatic mechanism, using steel direct from the crucible before refining.
9. The arrangement of a movable door or gate between the reduction chamber and the melting chamber, by which the hot containers are rolled quickly into the latter, without loss of heat from either chamber, and without the possibility of air entering the contaners and oxidizing the sponge within them.
10. The method of casting the containers from the melting chamber at a minimum of expense.
11. Providing hot materials to the melting chamber, instead of the usual cold charge, by which the melting is much facilitated and cheapened.
12. The heating, also in containers, of the 'additions' of lime, ferro-manganese, ferro-silicon, etc., and their incorporation with the melting charge.

A variety of products have been made by this process, ranging from a very soft iron containing not more than 0.01% carbon, through different grades of steel, up to the highly carburized material with two per cent carbon of exceeding hardness and suitable for stamp shoes and dies. Steel, for any use whatever, can be manufactured in this way, simply by varying the amount of combustible mixed with the ore, giving attention at the same time to the 'additions' made during the melting. And since manganese ore is reduced in the containers in the same way as iron, a very simple method of providing the ferro-manganese necessary is obviously open.

It is claimed that no other process of steel-making opens so many avenues for the manufacture of alloys, or is so easily controllable; and, further, that in no other process is there so little waste of fuel.

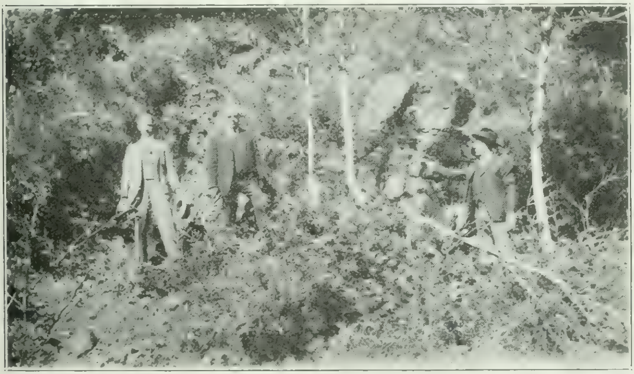
McKinney Iron Mines. This property includes all of the leaseholds controlled by W. McKinney and associates of San Luis Obispo covering the iron ore deposits in that part of the San Luis Range commonly called the Irish Hills or Los Osos Hills. The holdings comprise Lots



Map of McKinney Iron Mines property, San Luis Obispo County.

38, 39, 40, 70, 71, 72, 73, 74 and 48 of Rancho Cañada de Los Osos and la Laguna, lying mainly in what would be T. 30 S., R. 10 E. The most easterly outcropping of ore is in Prefumo Canyon and within 2½ miles of San Luis Obispo. From this point the iron ore veins have recently been traced in a general direction of N. 80° W. for a distance of approximately 5½ miles. The accompanying map of McKinney Mines shows the area, topography, and number of veins, as indicated by their outcrops.

Outcrop of iron ore on west side of Prefumo Canyon, McKinney Iron Mines, San Luis Obispo County.



Outcrop of iron ore west of Clark Valley, McKinney Iron Mines, San Luis Obispo County.

Both hematite and limonite ore occurs. At the eastern end limonite predominates, the most prominent exposure in Prefumo Canyon being a well-defined vein of dark brown or black glossy limonite, 10 feet in width. This vein or bed strikes N. 70° W. and stands nearly vertical. The walls are ferruginous sandstone and shale of Franciscan age. The ore has a laminated structure, the banding being parallel to the strike of the vein and bedding plane of the enclosing sedimentary formations, indicating contemporaneous deposition. Regarding the genesis of these iron ores, Harder,[1] who examined the eastern end of the deposit in 1910, says:

> "It seems clear that the iron ore of Prefumo Canyon is an original sedimentary deposit formed during an interval in the deposition of the inclosing sandstones and shales. The character of the ore, the bedding and fine laminations, and the included sedimentary beds all point to this conclusion. It is probably of the nature of a bog deposit which has been consolidated during the compression and folding of the accompanying strata * * *
>
> "The ore may have been deposited in a circular basin with a probable diameter of 5000 feet or more, which is the present length of the deposit,[2] or in an elliptical basin with one diameter of 5000[3] feet or more. Subsequent erosion after tilting has removed a large part of the bed. If it is considered that the deposit was originally circular in outline and that about half of it has been eroded, the vertical bed as it remains would have a depth of 2500[4] feet or more at the center and would gradually decrease in depth towards the ends. On the assumption that the bed has a fairly regular thickness of 10 feet, there would in this case be a great tonnage of low-grade ore left in the ground. However, the bed may have been originally elliptical instead of circular in outline, and if so the quantity of ore is uncertain within a wide range, depending upon whether the larger diameter is horizontal or vertical. Another uncertain factor is introduced by the fact that either more or less than half the bed may have been eroded. * * *"

The writer finds no reason to disagree with the theory of origin quoted, and allowing for the fact that the veins may vary in thickness or pinch out in places and that the grade of the ore may change, it still seems certain after considering the number of veins uncovered since Harder's examination and the distance over which they outcrop, that an enormous tonnage of ore is left in the ground. As confirmatory evidence, it is noted that the outcrops are found in place at points having a difference in elevation of nearly 1200 feet, but the only positive evidence of continuation at depth is at one point where a crosscut has intersected the ore at a depth of 150 feet below the surface.

The continuity of the several veins on their strike has not been definitely established, but continuous exposures, running 250 feet, are found and the thickness of the individual veins appears to be fairly consistent throughout their length. These widths vary from 10 to 30 feet. The veins on the eastern half converge at Johe Hill, where they have been somewhat disturbed, probably by igneous intrusions. Farther west above the old Goodwill Copper Mine, the formations are also disturbed, and the veins badly shattered. There is an exposure here of 30 feet of hematite ore. The veins from this point westward and across Clark Valley are in the main hematite.

---

[1] Harder, E. C., Some Iron Ores of Western and Central California, U. S. Geol. Survey Bull. 430, pp. 220–223, 1910.

[2] Later exploration has shown the orebodies to extend more than five times this distance.

[3] See Footnote 2, *ante*.

[4] See Footnote 2, *ante*.

The following analyses are given by Harder[1]:

	Iron	*Phosphorus*	*Silica*
1. Ore outcrop near creek (Prefumo), 11 feet of ore	44.80	0.500	15.41
2. Ore outcrop 2000 feet southeast[a] of No. 1	47.60	0.530	11.20
3. Ore outcrop 3000 feet northwest of No. 1	46.10	0.510	13.10

4. Mixture of samples 1, 2 and 3—

Iron	46.16
Silica	13.23
Phosphorus	0.513
Alumina	1.42
Lime	6.0
Magnesia	Trace
Manganese	0.20
Sulphur	0.639
Titanic acid	None

[a] Evidently from outcrop not on McKinney Iron Mines property.

Samples taken from the various veins by Mr. McKinney at points judged by him to give a fair average of the entire field are reported as follows:

Silica	Iron	Alumina	Lime	Magnesia	Phosphorus	Sulphur	Manganese
11.19	52.77	1.62	3.40	Trace	.89	Trace	0.46
10.41	49.49	2.40	3.90	Trace	.77	Trace	Trace
16.66	45.33	1.95	Trace	Trace	.45	Trace	0.28
13.60	46.67	3.50	1.08	Trace	.34	Trace	Trace
8.10	51.75	1.78	1.88	Trace	.54	Trace	0.32
12.50	50.21	0.47	2.65	Trace	.68	Trace	0.32
8.47	49.70	4.69	2.95	Trace	.69	Trace	0.84
8.13	52.65	1.63	3.40	Trace	.70	Trace	0.08
8.74	53.05	0.74	3.25	Trace	.75	Trace	Trace
9.66	47.85	3.07	1.03	Trace	.81	Trace	1.22
14.50	45.09	3.55	3.11	Trace	.67	Trace	0.88
11.60	51.23	2.48	0.39	0.20	.62	.12	1.18

Silica	Iron	Lime	Magnesia	Phosphorus	Sulphur	Manganese
7.33	50.52	2.65	0.32	0.58	0.044	0.84
7.11	55.10	Trace	Trace	0.227	Trace	0.66
6.07	53.85	2.05	0.36	0.62	Trace	1.80
8.13	52.81	1.68	0.50	0.61	0.033	1.66
12.55	43.67	3.55	Trace	0.66	Trace	0.40
12.86	48.24	Trace	0.50	0.27	Trace	1.03
5.05	50.78	3.25	0.33	0.82	Trace	1.46
9.46	51.28	Trace	0.45	0.46	Trace	1.78

Silica	Iron	Phosphorus	Sulphur	Lime	Magnesia
9.00	47.64	.81	0.025	4.25	.24
9.88	47.26	.86	0.030	4.80	Trace

Development work up to the present has consisted of surface exploration, surveying and mapping of the deposit; a small amount of crosscutting; sinking of test pits and sampling.

The deposit is accessible by road from Los Osos Valley at three points, up Prefumo Canyon at the east end, by way of Andrews Canyon near the center and up Clark Valley at the west. An excellent highway runs the length of Los Osos Valley, connecting San Luis Obispo and Morro Bay. The topography is such that a railroad line could be extended to the deposit at a low cost. The Pacific Coast Railroad main line from San Luis Obispo to Port San Luis passes within 2½ miles of the eastern end of the property. From here it is eight miles to the harbor. Port San Luis is a deep water harbor and a regular port of call for coast vessels and oil tankers.

Electric power is available within two miles and a large tank farm of the Union Oil Company is situated within three miles of the deposit.

Accessory minerals utilized in the iron industry are found within the county, occurring in part on the property; including limestone, dolomite, manganese, chrome, and diatomaceous earth.

---

[1] Harder, E. C., U. S. Geol. Survey Bull. 430.

W. McKinney, San Luis Obispo, is directing the interests associated in developing the property.

LIMESTONE.

Very little limestone has been mined and utilized in this county although many deposits of commercial size and good quality occur. The distance from transportation and limited local market has hindered development, but both of these factors are subject to constant improvement, and the limestone deposits may be considered as assets of considerable potential value.

The limestones occur mainly in the Monterey formation in both the Santa Lucia and San Luis Ranges. Deposits have been noted in Secs. 18 and 19, T. 26 S., R. 10, and some was burned here years ago; in the northwestern part of T. 32 S., R. 16 E., and eastern part of T. 32 S., R. 15 E., and in Sec. 36, T. 32 S., R. 14 E. There is an immense bed of fossil clam and oyster shells near the Oceanic Mine. Limestone has been burned in the past on the Newsom Estate near Newsom Springs. Another unexploited deposit occurs two or three miles north of Santa Margarita. Limestone is found in the San Luis Range on the McKinney Iron Mines property and at other points..

Tassajero Group. Three claims in Secs. 21 and 28, T. 29 S., R. 12 E., which cover a deposit of white, coarsely crystallized calcite, compose this group; owned by S. Aumaier, 1127 Monterey street, San Luis Obispo. The deposit is on the eastern slope of the Santa Lucia near the summit at the head of Tassajero Creek. There is a road up Tassajero Creek to within a short distance and several roads on the west side of the ridge extend as far as the chrome mines in the serpentine area, which cuts off the calcite veins on the south. Several veins have been exposed on the claims by short open cuts, the largest vein having a width of 12 to 14 feet. They have been traced the length of two claims. The property is 4½ miles from Santa Margarita, the nearest railroad station. An analysis of the calcite by Smith, Emery and Co. showed the following composition:

SiO_2	0.45%
Al_2O_3	0.19
Fe_2O_3	0.85
Mn_3O_4	0.80
CaO	54.24
MgO	0.42
Loss on ignition	43.40
Total	100.35

The sample is unusual in having an appreciable manganese content.

Lopez Canyon Group. This property comprises three claims located in 1924, and owned by S. Aumaier, 1127 Monterey Street, San Luis Obispo, Peter Roderjuez and S. J. Rhyne. They are situated in Lopez Canyon at the corner common to T. 30 S., R. 13 E., T. 30 S., R. 14 E., and T. 31 S., R. 13 E., T. 31 S., R. 14 E., in the Santa Barbara

National Forest. There is a road up Lopez Canyon leading directly to the claims. The limestone bed outcrops several hundred feet above Lopez Canyon Creek in the high ridge on the south side of the canyon, and is exposed at several points along its strike, which is northwest, and parallel with the canyon. The bed dips about 45° SW. into the ridge. The most prominent outcrop is at the junction of Fern Canyon and Lopez Canyon, where the former breaks in. The thickness of the bed is difficult to determine, as the hills are thickly covered with brush, but where exposed at the mouth of Fern Canyon, the ledge apparently has a thickness of 100 feet or more. Several thinner limestone beds outcrop at various elevations on both sides of the canyon.

The owners put up a small home-made kiln and burned a little of the limestone, but had difficulty in getting a high enough heat for complete calcination, as the draft was poor, the kiln being only about six feet in height. The lime that was well burned slaked rapidly and completely. It was white and appeared to be of good quality. No analyses have been made of this limestone, and it may be in part dolomitic.

MAGNESITE.

Small veins of magnesite occur on the *Kiser Ranch,* nine miles northwest of Cambria. The deposit is probably of no commercial importance.

Bibl: State Mining Bur. Bull. 91, p. 133. U. S. Geol. Survey Bull. 355, p. 38.

MANGANESE.

Several thousand tons of manganese ore were produced in San Luis Obispo County between 1918 and 1920. Active development of the deposits began as a result of the war demand for the metal and ceased when importation of foreign ores was resumed. Many deposits have been noted in the same general areas of the San Luis and Santa Lucia Ranges that produced chromite, and some of these deposits have proved to be high grade and of good size. None of the manganese mines are active at the present time. They have been described in detail in Bulletin No. 76, 'Manganese and Chromium in California,' and will be but briefly referred to in this report.

Evans Deposit. Manganese occurs on the property of W. and J. Evans, of San Simeon, in Sec. 3, T. 25 S., R. 6 E.

Hearst Ranch. There is a deposit on the Hearst Ranch, on San Simeon Creek, three miles from the wharf at San Simeon.

Johe Deposit. Owner, George J. Johe, San Luis Obispo. This deposit is at the head of Clark Valley, in the Los Osos Hills, seven miles west of San Luis Obispo by good road. It is undeveloped.

A. A. Muscio, 793 Buchon St., San Luis Obispo, has a manganese deposit near Cayucos, from which there has been a small output.

Phelan Ranch Deposits. Manganese outcrops strongly in T. 27 S., R. 8 E. on property of the Phelan Land and Cattle Co., R. and Jeff Phelan, Cambria, owners. The deposit is in the Pine Mountain district, eight miles from Cambria.

Riccioli Property. Manganese ore was developed on this property, owned by Victor Riccioli, of Cayucos. The deposit is seven miles southwest of Cambria and ¼ mile from the road between Cayucos and Cambria. It was under lease during the war.

Serrano Deposit. Manganese occurs on the Serrano property in Clark Valley, seven miles west of San Luis Obispo. There is a good road to the deposit. Not developed. Carlos Serrano, owner, P. O. Box 125, San Luis Obispo.

Stanusich Ranch Deposit. This was one of the principal properties worked during the period of the war activity, when it was under lease to the Manganese Co. of California. The deposit is situated south of Clark Valley in the Prefumo Canyon district, eight miles from San Luis Obispo by good road. A streak, six to eight inches wide, of chemical grade manganese oxide, occurs here as well as reserves of industrial grade ores.

Welsh Ranch Deposit. Deposits on this property, owned by J. C. Welsh, 1320 Palm street, San Luis Obispo, were developed under lease, and high grade ore was produced during the war period. The deposit is on the ridge south of Clark Valley, nine miles from San Luis Obispo by good road.

Bibl: State Mineralogist's Reports XII, p. 330; XV, pp. 689–690; State Mng. Bur. Bull. 76, pp. 69–74. U. S. Geol. Survey San Luis Folio 101. U. S. Geol. Survey Bull. 427.

MINERAL WATER.

A large number of mineral springs and wells having a wide variety of chemical salts in solution occur in various sections of the county. The better known and most improved springs and resorts are in the southwestern part and in and around Paso Robles. Other springs are found in the southeastern part and Carrizo Plain.

The direct monetary return from the sale of mineral water in San Luis Obispo County is small. Besides water, there is only one other merchantable product directly due to mineral springs. This is onyx marble, illustrated by the noted Kessler Mexican Onyx (travertine) deposit at Kessler Springs. Nevertheless, the mineral springs indirectly add much to the wealth and prosperity of the county, as the recreational attraction of the resorts and the medicinal qualities of the waters are brought to the notice of an ever-increasing traveling public; and they may properly be considered as one of the county's most valuable mineral resources.

Bitterwater Spring is one of several small springs in the southern part of Carrizo Plain. It is a watering place for live-stock.

Camela Warm Spring is located 30 miles southeast of Paso Robles. It has a small flow with a temperature of 74° F. and has been used to some extent for bathing.

Grand Central Sulphur Spring is located on property owned by the Frank Sparks Estate near the center of Paso Robles. It is in reality a well 510 feet deep, which has been capped and not utilized in any way for a decade.

R. C. Heaton Well. This well is situated on what was at one time a part of the James property, which included the Paso Robles Springs Hotel site. The tract containing the Heaton well is at 10th and Spring streets and comprises a city block, with the exception of one lot, adjoining the hotel grounds. Grace E. Heaton, Paso Robles, owner.

The well was drilled about 20 years ago and a large flow of mineral water, similar to that at the Hotel Springs, was developed. The well is 230 feet in depth, double cased, and cemented to a depth of 120 feet. The water has a temperature of 106° and is under a heavy hydraulic head. If permitted to flow freely it is estimated that it would run 500,000 gallons per day. There is an eight-room cement bath house, with cement tubs, sunk in the ground, for the owner's and tenants' use, but only a comparatively small part of the flow is utilized. The water is not bottled or sold.

Huer-Huero Springs. There are two groups of mineral springs on the Huer-Huero Ranch, located about 15 miles southeast of Paso Robles and 1½ and 3 miles south of Creston. They are cold and strongly sulphurated. The flow is small.

Kessler Springs are located at the Kessler Mexican Onyx Deposit and are noted because of the deposit of travertine which has formed about them. The flow is small and has a temperature of about 60° F. The water is not utilized. The 'onyx deposit' is described under the heading 'Onyx Marble.'

Merry Hill Mineral Well is situated on a hill about ¼ mile west of Paso Robles. Mrs. J. H. Pinkert, owner, Box 129, Paso Robles; F. L. Mercker, resident manager, Paso Robles. The well is 170 feet in depth, and does not have a large flow, as it can be pumped down in one-half hour, but it immediately fills again. The water is put up in gallon bottles, as it comes from the well and sold locally. The following analysis was made at the University of California a number of years ago:

	gr./gal.	parts/10,000
Potassium sulphate Sodium sulphate	5.39	.93
Sodium chloride	4.77	.81
Sodium carbonate	1.23	.21
Calcium and magnesium carbonate Calcium sulphate	17.52	3.00
Silica	.88	.15
Organic matter and chemicals Combined water	6.13	1.05
Total	35.92	6.15

A *Mineral Spring* is situated on the right hand side of the road from Paso Robles to Adelaide in Sec. 23, T. 26 S., R. 11 E. It is small, barely flowing at the time of visit; cold; and not utilized. A small amount of gas escapes at the surface of the water.

Municipal Baths Springs, in Paso Robles, is an artesian well 392 feet deep, having a flow reported to be 380,000 gallons per 24 hours. Hot sulphur water issues at a temperature of 108.6° F. and is utilized in a very substantial and well appointed municipal bathing pavilion.

Newsom's Springs are situated 2½ miles east of Arroyo Grande in T. 32 S. R. 13 E. They have been owned by the Newsom Estate since 1864, and the water, which contains iron, was used by the Indians before that time for medicinal purposes. According to former reports, the spring yielded about 15 gallons of water a minute at a temperature of 100.5° F. The owner states that there has been a noticeable increase in flow and temperature since the recent Santa Barbara earthquake, but no exact data are available. There are spacious grounds, which contain a small hotel, cottages, and bathing facilities surrounding the spring.

Ontario Springs (formerly *Budan Springs*). Mrs. E. Budan, San Luis Obispo, owner and manager. This spring is in reality an artesian well brought in during 1908 while boring for oil. The water comes up from a 3-inch pipe and has a temperature of 178° F., considerably higher than any other spring or well in the district. There are tub baths and a large outdoor plunge. The water is markedly sulphurated. Ontario Springs is located on the Coast highway, six miles south of San Luis Obispo, and is a popular swimming and bathing resort.

Paso Robles Hot Springs is one of California's most noted and popular pleasure and health resorts. The property is equipped with a magnificent hotel and bath house, completely equipped for the entertainment of guests and the treatment of ailments for which the mineral waters are recommended. There is a large plunge and varied equipment with skilled operators, who administer hot air and vapor baths, massage, exercises and other treatment to supplement the use of the water. The resort occupies a spacious site in Paso Robles, facing the Coast highway. The so-called main sulphur spring is an artesian well, 640 feet deep with a 10-inch casing, which has an enormous flow of hot sulphurated water. The temperature of the water is 107.6° F. and the flow is stated to be 2,000,000 gallons per day.

Paso Robles Mud Bath Springs are operated under the same management as Paso Robles Hot Springs. The mud baths are situated 2½ miles north of Paso Robles on the edge of Salinas River. The bath house here is equipped with packing rooms and concrete basins built into the mud springs. There is a constant ebullition of gases and mineral water through the mud. The temperature of the water varies from 104° to 122° F. and it is markedly different in mineral content from that at the Paso Robles Springs proper. Adjacent to the mud baths is a 4-inch well, 140 feet deep, called the Lithium Spring, yielding water having a temperature of 118° F. This water is used for drinking. A natural spring, called the Soda Spring, is situated a few yards away. It has a temperature of 77°. Water from this spring was formerly artificially carbonated and bottled by the Paso Robles Soda Works. The Iron Spring is another small spring with a temperature of 64°, containing a little more iron than the others; utilized for drinking.

Pecho Warm Springs are west of San Luis Obispo in Islay Creek, two miles from the ocean. There are several small springs in the group. One has a temperature of 95° F. and another a temperature of 72°. They have been known and used locally for many years but are not important.

San Luis Hot Springs (formerly *Sycamore Springs*). This property is situated six miles south of San Luis Obispo and ¼ mile from the Coast highway on the road to Avila. Properly speaking, this is not a spring, the water being obtained from an abandoned well bored for oil.

A large flow of hot sulphur water, having a temperature of 110° F. with a considerable quantity of gas, issues from the well and is utilized for bathing in plunges and tubs. There is a good hotel, cottages and other accommodations for guests located on the shaded grounds of this popular resort. Owned by Truppel and Truppel, San Luis Hot Springs, California.

Santa Ysabel Springs are located four miles southeast of Paso Robles. There are two principal springs, the larger of which has a flow of about 220,000 gallons per day and a temperature of 94° F. The springs are used locally for bathing, but the principal use made of the water is for irrigating the surrounding land.

Sulphur Spring. A spring of warm sulphur water rises near the bank of Tassajero Creek, about two miles west of the Coast highway opposite the foot of Cuesta grade on the Santa Margarita side. It flows about 15 gallons per minute, and is unimproved. Situated on the property of Gustave Renkert.

Bibl: State Mineralogist's Report XV, pp. 690–697; U. S. Geol. Survey Water Supply Paper 338; Anderson, Winslow, M. D., Mineral Springs and Health Resorts of California, 1892.

ONYX MARBLE.

Onyx is a banded variety of quartz. 'Onyx marble' or Mexican onyx is a variety of calcite, resembling true onyx. Mineralogically, it is either aragonite or travertine. Onyx marble is usually deposited by hot or cold springs or as stalactites in caves. It occurs at a few places in San Luis Obispo County.

Ezra Carpenter donated a sample of pale green onyx marble to the Mining Bureau Museum years ago. The locality from which it came is described as the SE¼ Sec. 9, T. 32 S., R. 15 E.

Kessler Onyx Marble Deposit. This deposit ranks as one of the largest and finest in the state. There are two patented mining claims surrounded by other land holdings of the Kessler Estate. The deposit is in Secs. 9 and 16, T. 31 S., R. 15 E., five miles north of Musick and about 17 miles northeast of Arroyo Grande. It was opened up in 1890, and during the nineties it is said that more than 1000 tons were shipped out, most of it going to the eastern states. The face of the quarry was 50 feet long, 20 feet high and a thickness of 15 feet of material was exposed. The onyx marble occurs in layers from 1 inch to 8 or 10 inches in thickness, and at one point, 30 inches. It is white, also banded and variegated or sometimes marked with red blotches. Some portions are banded with dark green color. The stone is translucent and takes an excellent polish. Blocks three to six feet square have been taken out and larger ones could be obtained by careful quarrying. No production has been made for many years, but the deposit was recently examined by Los Angeles parties who contemplate reopening it. The property is owned by the Kessler Estate, Anthony Kessler, manager. The surrounding Kessler lands are under lease to Arza Porter, Arroyo Grande, California.

Bibl: State Mining Bur. Bull. 38, pp. 111–112.

OIL SHALE.

A belt of oil shale strikes east-west across T. 29 S., R. 10 E. It is well exposed three miles west of Adelaide in the bed of Las Tablas Creek, which cuts across it at right angles. In Secs. 19 and 20 on the property of H. T. Ramage, the shale stratum is practically horizontal, the dip being not over 10°. It shows for one-half mile along the creek, but its thickness at right angles to the bedding plane has not been determined. A sample from a cut about two feet in depth in the creek bed, taken several years ago and sent to the laboratory of the Union Oil Company, is reported to have yielded 8⅓ gallons of 16.5 Baumé gravity oil to the ton. Material taken at some point distant from the creek bed and at greater depth would probably show a higher yield.

PETROLEUM.

The principal development is along Pismo Creek in the Arroyo Grande oil field, where there are a number of wells producing an average of about nine barrels each per day of 14° Baumé gravity oil.

A great deal of unsuccessful drilling has also been done in the county in the past, notably in the Huasna District, Carrizo Plains and Cuyama Valley. Nevertheless interest is being taken at the present time in prospective territory and the acquisition of new leases is more or less constantly under way. During the past year the following new wells have been reported ready to drill:

E. J. Miley, Lot 11, Rancho San Miguelito.
A. J. Crose, Sec. 34, T. 28 S., R. 13 E.
Henry R. Dabney, T. 27 S., R. 10 E.
Fox and McCoy, Lot 133, T. 27 S., R. 11, Walkin.
Lloyd Tevis, Sec. 12, T. 31 S., R. 21 E.
Livermore and Phelps, Sec. 8, T. 32 S., R. 22 E.
Barneberg Oil Co., T. 32 S., R. 15 E.
Carter Mullaly, Sec. 7, T. 32 S., R. 22 E.
E. F. Brittan, Sec. 27, T. 32 S., R. 12 E.
Paso Robles Gas Co., Sec. 19, T. 26 S., R. 12 E.

The geology and oil possibilities of the county are discussed in the publications listed in the bibliography, and oil field development operations are reported in current numbers of 'Summary Operations, California Oil Fields,' issued by the Department of Petroleum and Gas of the State Mining Bureau. The reader is referred to these publications for details regarding this branch of the mineral industry.

Bibl: State Mining Bur. Bull. 69 and Map Folio, 1914; Bull. 89, 1921. U. S. Geol. Survey San Luis Folio 101; XXII Annual Report, Pt. 1; Bull. 621; Bull. 406; Bull. 691.

PLATINUM.

This metal has been observed in some of the beach sands, but no profit has resulted from attempts to recover it. Logan[1] also states that traces of platinum in peridotite from the Santa Lucia Mountains near Santa Margarita in San Luis Obispo County are reported to have been found in analyses made by Baker and Company.

Bibl: State Mining Bur. Bull. 91, p. 24; Bull. 85, p. 95.

---

[1] Logan, C. A., Platinum and allied metals in California, 1918.

QUICKSILVER.

San Luis Obispo is a county of many quicksilver mines but few important producing properties. The first locations were made in 1862, and the period of maximum annual yield was reached in 1876. With two exceptions, all the mines that have produced quicksilver are located in the Santa Lucia Range from San Carpojaro Creek in the northwest corner of the county to the middle of T. 27 S., R. 10 E., a distance of about 30 miles.

At the time of visit in September, 1925, no metal was being produced at any of the properties, but some work was being carried on at two of them and a third was being examined with reopening in view. The quicksilver mines and prospects of the county are described in detail in Bulletin No. 78, 'Quicksilver Resources of California,' (1918) which also contains a geological map showing the principal districts. The data herein are intended to cover only new developments and changes since Bulletin 78 appeared, and detailed descriptions will be omitted. The condition of the industry during the past decade from 1915 to 1925, which includes the 'war period' of high prices and the post-war period of extremely low prices for the metal, is summarized in the following paragraphs:

In 1915 the La Libertad Mine made a small production, using a Johnson-McKay 12-pipe retort. The Cambria Mine was active and produced considerable quicksilver. The Oceanic made a notable output, while the Klau Mine, Josephine and Capitola were not productive.

During 1916 the Klau was equipped with an additional 12-pipe retort and some production was made. The Little Bonanza also made a small output. At the Oceanic the Scott furnaces were in operation, and a good production was recorded, but in October it was closed down. The Cambria Mine was shut down indefinitely in August. There was no activity at the Rinconada.

In 1917 the Deer Trail Mine, a new property, produced some metal, using a 12-pipe retort. The Little Bonanza and Josephine also made a small output. Early in the year the Klau was producing from retorts, but it closed down in a short time. The Oceanic was the most productive and the only property in the county operating at the end of 1917.

The Oceanic was likewise the only producing quicksilver mine in 1918 but one of its two 50-ton Scott furnaces was out of commission at the end of the year.

During 1919 operations were continued at the Oceanic with one 50-ton furnace in operation. The Klau Mine was reopened late in the year by the Carson Quicksilver Mining Co. Lessees on the Little Bonanza made a small output.

In 1920 the Oceanic ran until the end of October when the whole plant was closed down. The Klau also closed down, and there was no active property in the county by the end of the year.

None of the San Luis Obispo County mines were producers in 1921. During 1922 the reduction plant at the Rinconada was overhauled, and two trial runs made in November. The Klau and Oceanic remained idle.

With the exception of a few flasks recovered from the rotary furnace at the Rinconada Mine, none of the properties in the county were productive during the year 1923.

In 1924 there was a small output, which came from the Klau Mine where ore recovered in development work was treated in retorts. The Rinconada, Oceanic and other properties were idle.

Benton Ranch Deposit (Lehman Mine). This property is located in Sec. 13, T. 27 S., R. 9 E., 12 miles from Cambria. Now owned by A. F. Barton, Cambria, California. Idle.

Bibl: State Mineralogist's Report XV, p. 711; State Mining Bur. Bull. 27, p. 161; Bull. 78, p. 127.

Cambria Mine (formerly the *Bank Mine*). This property, in Sec. 36, T. 26 S., R. 8 E., made a good reputation as a quicksilver producer between 1905 and 1908. It was active thereafter, but was shut down for an indefinite period in August, 1916, development work having failed to locate an orebody, and it is probable that the Cambria Mine will never again be worked. The property is reported to be controlled by Earl Frazier, Ocean Park, California.

Bibl: State Mineralogist's Report XV, pp. 700–705; State Mining Bur. Bull. 27, p. 154; Bull. 78, pp. 128–131.

Capitola Mine and *Santa Monica Claim* were locations adjoining and covering extensions of the orebodies worked in the Klau Mine. They were abandoned by the original locators and later were taken up by interests connected with the Klau Mine and are now held in conjunction with it.

Bibl: State Mineralogist's Report XV, p. 705; State Mining Bur. Bull. 78, pp. 131–132.

Claus Group, see Rinconada Mine.

Cypress Mountain Group. This property consists of 160 acres of patented land in Secs. 1 and 2, T. 27 S., R. 9 E. Owned by Mrs. W. S. Forrington, Paso Robles, California. Idle.

Bibl: State Mineralogist's Report XV, p. 706; State Mining Bur. Bull. 27, p. 156; Bull. 78, p. 132.

Deer Trail Mine. Property consists of two claims and a millsite located in Sec. 32, T. 32 S., R. 16 E., and owned by H. H. Carpenter, John W. Adams, and Wm. Arebalo, of San Luis Obispo. This is one of the mines mentioned in the introductory paragraph as being located entirely away from the main quicksilver producing area, which is in the northwestern portion of the county. The Deer Trail is about seven miles east of Huasna post office and 20 miles from Arroyo Grande. The claims were located in 1915. It was equipped with a 12-pipe retort and about 70 flasks of quicksilver were produced before mining ceased. The claims cover a series of narrow calcite veins striking east across a low ridge trending north-south. The country rock is a metamorphic sandstone. The cinnabar occurs in knife-blade seams and vugs in the more or less brecciated calcite veins.

There is an upper tunnel, 80 feet in length, on the principal mineralized vein. A second tunnel about 50 feet lower was driven in on this vein and from this level the ore shoot was underhand-stoped to a depth of 40 feet and for a width of four to six feet. A third tunnel lower down connects with the bottom of this stope and from this tunnel level a winze was put down about 30 feet, which is said to be in ore at the bottom though the vein is narrow at this point. A fourth tunnel was started still lower down the hill to cut the orebody at a considerably lower depth, but it would have to be run several hundred feet to get under the ore shoot developed above, and the work was discontinued soon after starting it. Similar parallel calcite vein systems, both north and south of the main working, also show cinnabar, and they have been prospected a little in doing assessment work, which is being kept up. The production has been fair for the amount of work done, and it is quite possible that it may again be a producer.

All ore taken out was retorted in a 12-pipe bank now in poor condition and which would require repairing or rebuilding to make it usable. Water was obtained by pumping from a spring about one-quarter mile from the mine.

Bibl: State Mining Bur. Bull. 78, p. 133.

Doty Group. Holdings comprise five unpatented claims in Sec. 14, T. 26 S., R. 8 E. There have been no noteworthy changes at this property. Doty Brothers, owners, Cambria.

Bibl: State Mineralogist's Report XV, pp.706,719; State Mining Bur. Bull. 27, pp. 156, 165; Bull. 78, p. 133.

Elizabeth and Winona Group. Comprises two locations in Sec. 17, T. 27 S., R. 10 E. Idle. Owned by Mrs. Elizabeth Bagby, Adelaide.

Bibl: State Mineralogist's Report XV, p. 707; State Mining Bur. Bull. 27, p. 157; Bull. 78, p. 133.

Josephine Group (also *Tartaglia Group* or *George Mine*). Consists of two claims in Sec. 29, T. 27 S., R. 10 E. There have been no new developments at this property. Owned by Mrs. Elizabeth Bagby, Adelaide.

Bibl: State Mineralogist's Report XV, p. 720; State Mining Bur. Bull. 27, p. 157; Bull. 78, p. 134.

Keystone Mine. This mine is on patented land in Sec. 13, T. 26 S., R. 8 E., and is owned by Phelan Brothers, Cambria. It was a producer during the seventies, but has not been active in recent years.

Bibl: State Mineralogist's Reports X, p. 581; XV, pp. 113–114; State Mining Bur. Bull. 78, pp. 134–135; U. S. Min. Resources West of the Rocky Mountains, 1875, p. 14.

Kismet Group. Three claims in Sec. 7, T. 27 S., R. 10 E. Idle.

Bibl: State Mineralogist's Report XV, p. 114; State Mining Bur. Bull. 27, p. 159; Bull. 78, p. 135.

Klau Mine (also sometimes known as *Sunderland, Santa Cruz, Karl, Sierra Morena,* or *Carson Mine*). This property in Sec. 33, T. 26 S., R. 10 E., is the principal mine in the Adelaide district, and one of the largest and most developed quicksilver properties in the county. It was originally discovered in 1868 and has been an intermittent producer ever since. In 1902 it was the fourth largest producer in the state.

The history of the mine and a detailed description is contained in Bulletin No. 78, issued in 1918. Since the publication of the above report, the property has been acquired by the present owners, the Carson Quicksilver Mining Co., a Delaware corporation; home office, Wilmington, Delaware; Ellard W. Carson, manager, San Luis Obispo.

Development work since the last report has demonstrated the existence of three principal 'veins' or lines of ore shoots in the wide mineralized zone running through the property, instead of two noted in the earlier report. The writer's attention was also called to an apparent error in the former description where it was stated:[1] "Both these ledges are developed by the 60° inclined shaft sunk, it is stated, to a depth of 800′, but a large amount of drifting and crosscutting failed to reveal workable ore on the lower levels. These workings became so extensive that a raise to the surface for ventilation was required, and in the course of driving it the best orebody found in the mine was uncovered." Mr. Carson states that the 60° inclined shaft only reached a depth of 100 feet vertical, instead of 800 feet, and that the valuable orebody referred to was discovered between the main level and the surface. These old workings are now largely caved and inaccessible.

The nature of most quicksilver orebodies and the instability of the metal market have discouraged exploitation on a large scale, but the present price of around $84 per flask for quicksilver and the possibilities held out by the wet method of recovery, using alkaline solutions, have developed a renewed interest in this branch of mining.

The Klau Mine was recently examined, with reopening of the property in view, and it is probable that it will soon again be on the active list.

> Bibl: State Mineralogist's Reports IV, p. 336; X, p. 580, XXI, p. 336; XIII, p. 600; XV, p. 709–711; State Mining Bur. Bull. 27, p. 157; Bull. 78, pp. 135–138. U. S. Geol. Survey Mon. XIII, p. 382; Min. Res. West of the Rocky Mts., 1875, p. 14; 1876, p. 20. Mining and Sci. Press, Nov. 12, 1904.

La Libertad Mine. This mine is in Sec. 21, T. 27 S., R. 10 E., in the Adelaide district, and was operated for a time during the war years, under lease by the Belt Quicksilver Mining Co. It has also been known as the Jacks' Mine. Owner, Mrs. Elizabeth Bagby, Adelaide, California. Idle.

> Bibl: State Mineralogist's Report XV, p. 700; State Min. Bur. Bull. 27, p. 159; Bull. 78, p. 138.

Little Bonanza (formerly *Josephine;* also *Alice* and *Modoc*). This is reputed to be the first quicksilver mine worked in San Luis Obispo County. It consists of a patented claim in Sec. 17, T. 27 S., R. 10 E., in the Adelaide district, owned by an eastern estate. Lessees made a small production about 1916, but it has been idle since.

---

[1] State Mining Bur. Bull. No. 78, page 137.

> Bibl: State Mineralogist's Reports X, p. 580; XV, p.711; State Mining Bur. Bull. 27, p. 154; Bull. 78, pp. 138–139. Min. Res. W. of Rocky Mts., 1875, p. 14.

Madrone Mine is in Sec. 22, T. 27 S., R. 10 E., adjacent to the La Libertad property. It was a producer about 1900, but the workings are all superficial. Idle. Owner, John Carmine, Cayucos, California.

> Bibl: State Mineralogist's Report XV, p. 712; State Mining Bur. Bull. 27, p. 161; Bull. 78, pp. 139–140.

Mahoney Mine (also called *Gould* or *Buena Vista*). This is on patented property in Sec. 33, T. 26 S., R. 10 E., lying southeast of the Klau Mine. Owner, Miss Mary I. O'Toole, San Jose. Idle.

> Bibl: State Mineralogist's Report XV, p. 712; State Mining Bur. Bull. 27, p. 161; Bull. 78, p. 140.

North Star Mine (*Santa Maria*). In Sec. 13, T. 25 S., R. 6 E. Idle for years.

> Bibl: State Mineralogist's Report XV, p. 712; State Mining Bur. Bull. 27, p. 161; Bull. 78, p. 140.

Oceanic Mine. This well-known quicksilver mine comprises large holdings in Secs. 15 and 21, T. 27 S., R. 9 E., five miles easterly from Cambria on Santa Rosa Creek. The original claims were patented in 1865. Production began in 1876. It has been closed down at various intervals since, due to depressions in the quicksilver mining industry, but it ranks as the largest quicksilver producer in San Luis Obispo County and one of the important mines of the state. It has been extensively developed and well equipped with mining and reduction works; the latter including two 50-ton Scott furnaces.

A detailed history and description of the Oceanic, including a map of the mine workings, is contained in Bulletin No. 78, published in 1918. At that time it was owned by Murray Innes, 217 Kohl Building, San Francisco, and was in active operation. The property continued to produce until the end of October, 1920, when it was closed down. The mine remained idle until July, 1925, when it was taken over by the Metals Exploration Co., 725 Standard Oil Building, San Francisco. Harry Payne Whitney and R. H. Channing are reported to represent the principal financial interests back of this move. The plans of the present operators are to deepen what is known as the new shaft (winze) 200 feet and then drift north to the orebody. If this work develops sufficient ore, the mine will be operated on a large scale, but if the exploratory work outlined fails to uncover an orebody, it is stated that all operations will cease. The sinking of the new shaft (winze from the main tunnel working level) had just begun at the time of visit

(September, 1925). Seventeen men were employed. M. A. Roche, superintendent.

> Bibl: State Mineralogist's Reports IV, p. 366; VIII, p. 531; X, p. 580; XII, p. 366; XIII, p. 600; XV, pp. 712–718; State Mining Bur. Bull. 27, pp. 151, 162, 243; Bull. 78, pp. 140–146. U. S. Geol. Survey Mon. XIII, p. 382; Min. Res. W. of Rocky Mts., 1875, p. 14; 1876, p. 20. A. I. M. E. Bull., Feb. 1915, pp. 497–504; Trans., Vol. LI, pp. 110–119. E. & M. J., Vol. 102, p. 512, 1916.

Pine Mountain Group. These holdings, in Secs. 3, 10, and 11, T. 26 S., R. 8 E., have been idle for years and are now a part of the cattle ranges of the Hearst Estate.

> Bibl: State Mineralogist's Reports VIII, p. 531; X, p. 580; XV, p. 718; State Min. Bur. Bull. 27, pp. 163–165; Bull. 78, pp. 146–147.

Polar Star Mine (also called *Santa Clara* or *Black Hawk*). Comprises two claims in Sec. 13, T. 25 S., R. 6 E. There were some early operations here between 1870 and 1900. The claims were relocated in 1915. Idle. Last known owner, A. L. Carpenter, San Luis Obispo.

> Bibl: State Mineralogist's Reports X, p. 581; XII, p. 366; XV, p. 718; State Min. Bur. Bull. 27, p. 165; Bull. 78, p. 147.

Rinconada Mine (also called *San Jose Valley Mine*). This property, like the Deer Trail, is quite apart from the main quicksilver belt of the county, which is in the northwestern part; it being situated 11 miles southeast of Santa Margarita. The mine is an old one located in 1872, and was worked by various owners in the past who are said to have produced considerable quicksilver by working the rich surface exposures and outcrops. In 1876 it was equipped with a special sheet-iron type of furnace which did not work well. Later two benches of 10-pipe retorts were put up.

The property includes Quicksilver Claim No. 1, No. 2, Amended No. 5, and Pedraita O, also the right to mine from Lot 2, Sec. 28, T. 30 S., R. 14 E., M. D. M., and two mill-sites, the Tenderfoot and Pedro. Owners, Cecilia P. and Chas. T. Claus, Santa Margarita.

The mine was leased in September, 1921, to W. B. Ewalt and A. Ledeboer, of Atascadero, who sub-leased to other parties. The mine was equipped with a 4′ x 50′ rotary furnace, operated by a 20-h.p. Fairbanks-Morse gas engine and other equipment. Two trial runs were made resulting in a small production, but disagreement arose among the operators and they quit.

The Ewalt and Ledeboer lease was renewed in 1923, and the mine was again sub-leased to the Santa Lucia Mining Corporation, a Delaware corporation, Suite 717, C. C. Chapman Building, Los Angeles, the principals of which are E. E. Peacock, L. E. Jones, John G. Bryson, and S. G. Davis. Some innovations were made in the furnace construction, including an inner tube 18 inches in diameter, but this failed to work mechanically when the furnace became hot, and it had to be torn out. Overhauling, changes and repairs to the reduction plant had occupied attention and was still in progress at the time of visit

(September, 1925), but it was expected that the plant would be ready in two weeks. One miner was employed and four men on top. The country rock is mainly serpentine. There are good-sized croppings of ore, but practically no tonnage developed ahead. Two additional claims, owned by Cecilia P. and Chas. T. Claus, are not included in the property under lease.

Bibl: State Mineralogist's Reports X, p. 581; XII, p. 366; XIII, p. 531; XV, p. 719; State Mining Bur. Bull. 27, p. 166; Bull. 78, pp. 147–148. U. S. Geol. Surv. Mon. XIII, p. 381.

There have been no changes noted at the *Sunset View*, the *Vulture Mine*, the *Warren Ranch* prospect, or the *William Tell Mine* since they were described in Bulletin No. 78, 1918.

Wittenberg Mine in Sec. 8, T. 27 S., R. 9 E., near the Oceanic, is now owned by Peter Silacci, Cambria, California. Idle.

Bibl: State Mining Bur. Bull. 78, p. 149.

SAND AND GRAVEL.

Templeton Sand Plant. This plant was built in 1915. It was originally run by steam power and operated by the California Highway Commission. It is now owned by the Granite Rock Company, of Watsonville, and operated by the Central Supply Company, which has a branch office in San Luis Obispo. The plant is situated on the bank of the Salinas River at Templeton beside the Southern Pacific tracks, on a spur from the main line. A drag-line bucket is used to excavate and raise the sand to the top of the plant where it is dumped, screened and run direct to cars without washing. A 40-h.p. electric motor operates the bucket line. The plant has a maximum capacity of 3 cars per day, and 2 men are required to operate it.

SODIUM SULPHATE.

Consolidated Chemical Co. This company controls a large acreage comprising the greater part of Soda Lake in Carrizo Plain from which there has come a considerable output of sodium sulphate, known to the trade as 'salt cake.' The company was incorporated in July, 1912, with an authorized capital of $1,000,000. Ed. Sutter, president; J. C. Long, secretary; home office Dimock Building, Lompoc, California.

Soda Lake is situated in T. 31 S., R. 20 and 21 E., and covers an area of 2800 to 3000 acres. The lake receives the drainage of Carrizo Plain and has no outlet. However, as evaporation in this region exceeds the rainfall, the lake is dry except after heavy storms, and its surface is covered with a layer of white crystalline salts leached from the surrounding formations. The deposit is principally sodium sulphate in the form of the mineral mirabilite (Glauber's salt) with some blödite associated. The surface of the underlying mud is covered with shallow saucer-like depressions and the thickness of the sodium sulphate crust varies from one inch near the circumference of the depressions to six inches at the center. There are also some deep channels that have been filled. According to Gale[1], the available salines amount to not less than 1,000,000 tons.

---

[1] Gale, Hoyt S., U .S. Geol. Survey Bull. 540, p. 428.

He also gives the following analysis of the material:

	Per cent
Insoluble	0.40
Al_2O_3	.04
MgO	1.66
CaO	.45
Na_2O	40.50
K_2O	.28
H_2O	3.65
CO_2	----
SO_3	46.12
Cl	9.27
	102.37
Less O	2.09
	100.28

The company erected a plant at the south end of the lake for evaporating the saline water and recovering the solid salt, but operation of the plant has been intermittent. The limited market for 'salt cake' and the long haul of 28 miles to McKittrick, the nearest shipping point, makes exploitation difficult.

The deposit was last worked under lease by the *Pacific Distributing Corporation*, 85 Second street, San Francisco: H. G. Frank, president and general manager.

This company began operating in February, 1923, and continued until April, 1925, since which time the plant has been idle.

Much additional machinery was installed at the plant and a total of seven miles of narrow-gauge railroad was built on the lake, over which the crude sodium sulphate was hauled in cars by a gasoline locomotive to the plant. The crude salt was crushed, washed, dried in centrifugals, sacked, and hauled to McKittrick by auto trucks. The plant was operated by electric power, from 80 to 100 horsepower being required. Steam from an oil-fired boiler was also used in processing. During the first year from 40 to 60 tons of sodium sulphate were produced per day, but the output dropped to 20 to 30 tons per day the second year.

The Consolidated Chemical Co. is planning the installation of a more economical system of handling the material before operations are resumed.

Bibl: State Mineralogist's Reports VIII, p. 532; X, p. 563; XV, p. 127; XVII, p. 386. State Min. Bur. Bull. 24, p. 136. U. S. Geol. Survey Bull. 280, p. 369; Bull. 540, p. 428.

STONE INDUSTRY.

Rubble and Crushed Rock.

There are no commercial rock crushing plants operating in the county, although in former years a number of plants have been located here.

Southern Pacific Company has a very large quarry and rock-crushing plant for supplying their own needs situated in Calf Canyon about three miles northeast of Santa Margarita. The rock is a coarse-grained granite, which is broken in large blocks for rubble and riprap. There is also a crushing plant containing three large gyratory crushers, secondary crushers, screens, etc., for producing broken rock of various sizes. The plant is on a spur branching from the main line about three miles north of Santa Margarita. It is operated by electric power, but was shut down temporarily at the time of visit, and detailed data were not obtained.

Building Stone.

Many varieties of stone have been used in the county for building purposes, for curbing, culverts, foundations, and to a small extent for monumental purposes. There are many deposits of suitable rock, but the limited market for such material has caused all former quarries to close down, and there has been no cut stone produced for a decade or more. The most important quarries are listed herein. Descriptions will be found in the reports listed in the bibliography.

Bishop's Peak Quarry. Considerable building stone has come from two quarry openings on the side of Cerro Obispo, just outside of San Luis Obispo.

Caen Quarry. Formerly operated in Sec. 36, T. 32 S., R. 13 E., M. D. M., and in Sec. 26, T. 12 N., R. 35 W., S. B. M.

Lee Quarry, in Sec. 17, T. 30 S., R. 12 E., M. D. M.

Moore Quarry, in Sec. 31, T. 12 N., R. 35 W., S. B. M., near Los Berros.

Morro Rock. Stone was quarried here for the breakwater at Port Harford.

Bibl: State Mineralogist's Report XV, pp. 722–724; State Mining Bur. Bull. 38; U. S. Geol. Survey Folio 101.

VOLCANIC ASH.

Francis Cleaner Mine. Owner, M. L. Francis, R. D Box 233, Paso Robles. The Francis property comprises 480 acres of patented land in Secs. 21 and 22, T. 28 S., R. 15 E., M. D. M. There is a large deposit of indurated white volcanic ash interbedded with siliceous shale and sandstone, exposed by creek erosion at several points from $\frac{1}{8}$ to $\frac{1}{4}$ of a mile apart on the property. Very little work has been done on it, but the stratum of volcanic ash appears to be not less than 20 feet in thickness and of uniform quality wherever exposed. The formations have no appreciable dip. The deposit apparently covers about 25 acres, but there is considerable overburden over most of it. The character of the material was not discovered by the owner until 1923, since which time several tons have been taken out. This was ground at a local feed mill, put up at home by the owner in the form of polishing powder and soap and sold by house-to-house canvassing. Users report it to be very satisfactory, but the owner lacks the capital to handle it on a large scale. The deposit is at an elevation of 1500 feet and is easily accessible. It is 24 miles by good road from Paso Robles or 16 miles from Santa Margarita, the nearest railroad station, over a road with more grades. A permanent water supply would have to be developed by well, as the creeks are dry except in the rainy season.

LOS ANGELES FIELD DIVISION.

W. Burling Tucker, Mining Engineer.

SANTA BARBARA COUNTY.

Introduction.

The area comprising Santa Barbara County was mapped and named in 1602 by the Spanish Expedition, which set out from Mexico under Vizcaino. In 1786 Padre Junipero Serra established the Central Mission of the Franciscan Fathers, where the city of Santa Barbara now stands. The county was created February 18, 1850, and is one of the original twenty-seven counties of the state.

Santa Barbara County consists of 2740 square miles, including the islands of San Miguel, Santa Rosa, and Santa Cruz, which are located twenty miles off the coast. It is bounded on the north by San Luis Obispo County, on the east by Ventura County, on the south by the Santa Barbara Channel, and on the west by the Pacific Ocean.

The population, according to the census of 1920, was 41,097, and is now estimated as over 50,000. The city of Santa Barbara, the county seat, with a population of over 30,000, lies on the shores of the channel. Santa Maria is the second community in Santa Barbara County and has a population of over 5000.

Topography.

Much of Santa Barbara County is hilly and mountainous; the Santa Ynez, a low range of mountains, follows the trend of the coast across the southern part of the county; and the San Rafael, a higher range, strikes through the center of the county and extends almost to its northern limits. These mountains, with their foothills and spurs, impart to the whole county a rugged and diversified aspect.

The principal valleys are the Santa Maria, Los Alamos, Lompoc, Santa Ynez, and Cuyama valleys. These fertile areas are well adapted for the growing of cereal crops, citrus fruits and cattle raising.

Streams.

The principal drainage systems of the county are the Santa Maria and the Santa Ynez rivers. The former is the natural boundary between Santa Barbara and San Luis Obispo counties. It rises in the high mountains in the northwestern part of Ventura County and flows westward, draining the Cuyama and Santa Maria valleys. The Santa Ynez River, flowing west between the Santa Ynez and San Rafael mountains, traverses the entire length of the county. Los Alamos Creek flows westward draining the Los Alamos and San Antonio valleys. These streams constitute the only large streams in the county.

Water supply.

The city of Santa Barbara secures its water from the Gibraltar Dam on the Santa Ynez River, which impounds a lake several miles long. From this reservoir the water is conducted by a three-mile tunnel through the Santa Ynez range to a distributing station.

Climate.

The climate of Santa Barbara County is equable throughout the year, the average annual temperature being 60° F. The western coast region is subject to heavy fogs and strong ocean winds. The southern coast is more sheltered, and fogs occur rarely. The rainfall varies from rather light in the valleys to 20 inches on the coast, this being confined to the winter and spring months.

Transportation.

The county is traversed by the Southern Pacific Railroad which follows the coast line, with branch lines from Guadaloupe to Betteravia, and from Surf to Lompoc. The Pacific Coast Railroad, a narrow-gauge line, runs from Port Harford, in San Luis Obispo County, through Santa Maria to Los Olivos, with branches from Santa Maria to Betteravia and Sisquoc. Santa Maria Valley Railroad connects with the Southern Pacific Railroad west of Santa Maria and runs southeast through the Santa Maria Valley to Leonard.

The coast route of the State Highway enters the county north of Santa Maria, and runs the length of the county, connecting Santa Barbara City with Los Angeles and San Francisco. Different laterals from this highway afford transportation for auto trucks and stages to interior towns.

Mineral resources.

Santa Barbara County owes its position of sixth in the state in regard to its mineral output to the presence of productive oil fields within its boundaries. The total value of its mineral production during the year 1923 was $5,005,782; of this amount the value of natural gas and petroleum was $2,567,158.

Among its mineral resources both developed and undeveloped are: Asphalt and bituminous rock, barytes, brick, chromite, copper, diatomaceous earth, gilsonite, gold, gypsum, limestone and lime, manganese, mineral water, natural gas, oil shale, petroleum, sandstone and the stone industry. The attached table gives the complete recorded output and value of the minerals of the county from the earliest available record for 1881 to and including 1924.

SANTA BARBARA COUNTY MINERAL PRODUCTION, 1881-1924.

Year	Petroleum		Natural gas		Asphalt—bituminous rock		Mineral water		Diatomaceous earth		Brick		Limestone		Sandstone		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
	Barrels	Value	M Cubic feet	Value	Tons	Value	Gallons	Value	Tons	Value	M	Value	Tons	Value	Cubic feet	Value		Amount	Value	Substance
1881	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	$2,000	Gold.
1882	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	
1889	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	41,423	Gold.
1890	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	10,293	Gold.
1891	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	2,478	Gold.
1892	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	896	Gold.
1893	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	
1894	1,800	$1,800	--------	--------	4,550	$91,000	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	
1895	16,904	12,678	--------	--------	23,950	139,000	22,500	$3,000	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	4,000	Gold.
1896	39,792	35,813	--------	--------	18,430	317,910	31,500	20,300	--------	--------	--------	--------	--------	--------	5,000	$500	--------	12 ozs. --------	44 8,592	Platinum. Gold.
1897	130,136	130,136	[3]500	$246	18,047	318,000	65,000	30,000	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	3,000	Gold.
1898	132,217	112,549	[3]165	135	19,735	351,400	15,000	7,000	--------	--------	100	$700	--------	--------	--------	--------	--------	--------	1,000	Gold.
1899	208,370	191,228	150	120	6,058	121,160	15,000	5,000	--------	--------	120	960	--------	--------	--------	--------	--------	--------	--------	
1900	183,486	165,138	1,203	2,966	5,270	105,500	19,000	10,350	--------	--------	4,620	40,060	7,205	$3,602	224,820	117,260	$82,662	--------	--------	
1901	203,616	113,385	[3]870	438	4,145	55,800	113,780	60,200	--------	--------	1,250	9,825	--------	--------	72,000	27,100	33,400	--------	--------	
1902	230,440	181,313	937	375	1,259	12,500	105,280	60,200	362	$2,172	1,400	12,200	10,000	25,000	74,200	21,500	--------	--------	200	Gold.
1903	262,226	149,640	320	320	2,974	41,688	88,800	22,280	2,700	15,925	4,900	46,200	20,000	40,000	52,654	34,240	4,395	30,000 bbls.	30,000	Lime.
1904	790,000	445,560	3,000	1,500	9,000	100,000	118,000	18,249	6,950	112,282	1,120	8,420	6,000	12,000	5,000	3,600	--------	--------	--------	
1905	3,534,000	1,413,600	--------	--------	3,000	30,000	115,250	21,450	3,000	15,000	4,025	34,750	5,000	7,500	29,000	18,330	57,792	52 flasks --------	2,070 725	Quicksilver. Gold.
1906	4,876,000	1,237,250	1,000	500	25,000	250,000	13,750	10,450	2,300	13,800	200	1,600	8,000	16,000	36,195	25,230	9,732	-------- --------	2 250	Silver. Gold.
1907	8,392,623	4,166,661	600	300	19,192	258,549	39,480	24,250	2,531	28,048	1,615	14,650	15,000	30,000	39,740	37,566	4,950	60 flasks	2,289	Quicksilver.
1908	8,847,589	4,423,794	715,612	357,806	7,000	70,000	5,500	4,932	2,050	32,012	750	7,500	16,580	33,160	10,525	6,545	10,930	--------	--------	
1909	8,110,788	4,069,601	768,000	394,621	200	2,488	155,400	22,200	--------	--------	990	9,180	4,849	6,619	31,120	10,648	5,316	--------	89,254	Unapportioned, 1900-1909.
1910	7,682,555	3,856,222	9,198,000	1,393,250	--------	--------	155,000	21,500	1,343	14,117	1,900	16,825	4,028	7,898	39,720	15,888	6,035	70 flasks	3,225	Quicksilver.
1911	6,766,156	3,204,717	[3]1,003,860	100,386	--------	--------	73,640	15,900	1,344	13,720	1,600	13,800	4,239	8,174	58,076	29,507	6,602	50 flasks	2,301	Quicksilver.
1912	6,862,719	3,747,045	[3]3,425,000	253,633	11,120	5 556	105,000	11,550	1,129	13,074	2,615	17,150	5,327	11,066	4,500	1,670	17,480	12,000 tons 17,500 bbls.	16,000 16 434	Clay. Lime.
1913	6,291,076	3,151,725	5,000,300	254,815	10,000	10,000	112,500	108,130	6,895	28,960	3,000	24,000	5,884	19,623	4,500	1,570	11,450	12,000 tons 26,512 bbls.	16,000 25,910	Clay. Lime.
1914	4,325,787	1,989,862	6,313,380	378,802	25,000	50,000	160,400	152,432	[2]	--------	2,100	16,800	6,157	11,263	9,286	1,850	15,300	--------	70,000	Other minerals.
1915	5,634,534	3,442 700	3,193,368	279,697	--------	--------	189,026	156,175	--------	--------	1,800	14,400	5,956	10,006	29,900	6,488	13,900	--------	61,600	Other minerals.
1916	4,502,206	3,574,752	3,660,140	724,746	[2]	--------	176,608	110,200	[2]	--------	[2]	--------	[2]	--------	3,520	1,017	12,395	--------	111,919	Bituminous rock, brick, 'granite,' diatomaceous earth, limestone, quicksilver.
1917	5,631,503	4,550,303	3,104,170	227,507	--------	--------	104,991	86,026	[2]	--------	[2]	--------	[2]	--------	28,700	6,110	6,950	97 tons --------	126,830 150,315	Potash. Brick, diatomaceous earth, limestone, quicksilver.
1918	7,334,104	9,057,618	4,150,316	338,030	[2]	--------	73,117	97,162	[2]	--------	[2]	--------	3,790	18,830	[2]	--------	11,613	1,863 tons --------	256,780 271,792	Potash. Bituminous rock, chromite, brick, diatomaceous earth, quicksilver, sandstone.
1919	6,089,082	6,850,217	4,084,709	336,092	[2]	--------	82,147	81,041	[2]	--------	[2]	--------	[2]	--------	--------	--------	20,900	298 tons --------	30,128 267,539	Potash. Bituminous rock, chromite, brick, diatomaceous earth, limestone.
1920	5,803,583	9,140,643	1,359,665	128,126	[2]	--------	95,843	110,931	[2]	--------	[2]	--------	--------	--------	[2]	--------	27,436	410 tons --------	40,000 1,091,475	Potash. Bituminous rock, brick, diatomaceous earth, quicksilver, sandstone.
1921	5,465 942	9,122,657	1,544,892	145,179	[2]	--------	97,847	133,590	[2]	--------	--------	--------	--------	--------	[2]	--------	65,600	143 tons --------	5,720 718,183	Potash. Bituminous rock, diatomaceous earth sandstone.
1922	3,931,155	3,974,398	1,876,900	167,290	[2]	--------	110,552	52,269	[2]	--------	[2]	--------	--------	--------	[2]	--------	72,300	--------	347,101	Bituminous rock, brick, diatomaceous earth, potash, sandstone, shale oil.
1923	3,001,947	2,394,443	1,612,287	172,725	[2]	--------	81,200	80,300	[2]	--------	--------	--------	--------	--------	[2]	--------	14,324	--------	2,344,090	Bituminous rock, diatomaceous earth, sandstone, shale oil.
1924	2,905,181	3,009,768	1,643,355	158,836	[2]	--------	[2]	--------	[2]	--------	[2]	--------	[2]	--------	[2]	--------	75,305	--------	1,915,831	Clay and clay products, bituminous rock diatomaceous earth, mineral water, shale oil.
Totals	118,253,577	$87,917,266	52,758,705	$5,818,447	[3]213,030	$2,420,641	2,541,111	$1,537,067	[3]31,504	$290,010	[3]34,105	$289,920	[3]128,015	$261,341	[3]780,956	$366,750	$594,767	--------	$8,087,689	

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.
[2] See under 'Unapportioned.'
[3] Quantity estimated, as only value originally reported.

METALS.

COPPER.

Small deposits of copper ore occur along the southwest slope of the San Rafael Mountains northeast of Los Olivos. The croppings strike east, and may be traced for a distance of about four miles. The ore is azurite, malachite, and chalcopyrite associated with quartz in mineralized shales. A number of claims have been located along these croppings and some development has been done on them, and also on the La Laguna Ranch, but there has been no actual production.

Copper King Mine comprises nine claims located in the San Rafael Mining District, in Sec. 5, T. 7 N., R. 29 W., S. B. M., 12 miles northeast of Los Olivos. Owner, F. B. Montanaro, Los Olivos.

Development consists of a crosscut tunnel about 75 feet in length. The ore is chalcopyrite associated with pyrite in a quartz gangue. Worked for assessment only.

Bibl: State Mineralogist Report XV, p. 735.

Laguna Ranch Mine is owned by the *Laguna Ranch Company*, W. H. Bradley of Pasadena, secretary. Formerly operated under lease by P. B. Montanaro, Los Olivos. This deposit is on the Laguna Ranch, three miles directly west of the Copper King group of claims.

The ore croppings show azurite and malachite associated with quartz, in a zone of mineralized shales 40 feet wide. The strike of the vein is east, and dip about 45 degrees north. The development consists of two tunnels driven on the vein. Idle.

Bibl: State Mineralogist Report XV, p. 735.

GOLD.

Gold and platinum occur in the black sands that are deposited more or less continuously along the beaches, from Pt. Arguello north to the mouth of the Santa Maria River. The most important deposits are 2½ miles north of Surf, and north of Point Sal. The black sands lie in strata from two to four inches thick, and are covered by layers of beach sand up to several feet thick. A great many attempts have been made to extract the fine gold and platinum from the black sands, and small amounts have been recovered, but so far no successful method has been evolved for the extraction of these precious metals on a commercially profitable scale.

Bear Creek Placer Mine is located along the beach extending from the mouth of Bear Creek to Surf. A. W. Wreske and associates of Anaheim have installed a small test plant at the mouth of Bear Creek, 2½ miles north of Surf, a station on the Southern Pacific Railroad.

The plant consists of a bucket elevator, which elevates the sands from a pit on the beach to a revolving screen. The material from the screen goes to a hopper, from which it is delivered by screw conveyor to a belt conveyor, and is then transported to two hoppers.

The sands from the hoppers are washed over amalgam plates, and then over a set of riffles to a tank. Sands from the tank are disposed of by a screw conveyor. The plant is driven by electric power generated by gas engines. The plant was not operating when the property was visited, being shut down for the purpose of installing a pump to raise the sands direct to the hopper, it being the intention to replace the conveyor system of delivering sands above the plates. The black sands at this point are in strata one-half inch to four inches thick, overlain by layers of beach sand from one to three feet thick. The black sands are reported to have a value of from $1.00 to $2.00 in gold, and .01 to .03 ozs. in platinum. Three men are employed.

Bibl: State Mineralogist Reports VIII, p. 537; X, p. 598; XV, p. 736.

MANGANESE.

Manganese occurs on the southwest slope of the San Rafael Mountains, ten miles northeast of Los Olivos.

Laguna Ranch Deposits. Several outcrops of manganese occur on the Laguna Ranch, ten miles northeast of Los Olivos, and two miles north of the Cavanaugh Ranch. The property is owned by the *Laguna Ranch Company*, W. H. Bradley, secretary, Pasadena, California. A number of small lenses of jasper, heavily stained with manganese oxides, outcrop on a ridge northeast of Figueroa Canyon. These lenses strike east, but are small in extent. A sample of ore taken from one of the outcrops is said to have assayed 70% MnO_2, and 12.35% silica.

Bibl: State Mining Bureau Bulletin No. 76, p. 75.

PLATINUM.

Platinum occurs with gold in the black sands that are deposited along the beaches near Surf and north of Point Sal. Some platinum has been taken from these deposits.

QUICKSILVER.

Commercial deposits of quicksilver occur in Santa Barbara County, in the Santa Ynez Mountains, eight miles north of Santa Barbara, and on the southwest slope of the San Rafael Mountains, twelve miles east of Los Olivos.

Quicksilver was discovered in Santa Barbara County at the Los Prietos Mines, in the Santa Ynez Mountains in 1860. Seven years later, cinnabar was found in Acachuma Canyon, in the San Rafael Mountains. In both of these localities quicksilver has been mined intermittently for many years; but no segregated records of its production previous to 1893 are available. The published records show that from 1893 to 1918, the total production was 263 flasks, valued at $14,081. At the present writing there is no activity in quicksilver mining in the county, only annual assessment work being done. It is hoped that with the recent increase in the price of the metal, interest in the old mines in these districts will stimulate renewed activity in their development.

Acachuma Mine comprises three patented claims located in Sec. 2, T. 7 N., R. 29 W., S. B. M., 12 miles east of Los Olivos, at the head of Acachuma Creek. Owners are D. D. Davis, Edward Dalton, and the C. Woods Estate of Los Olivos.

The property was formerly worked by the *Red Rock Quicksilver Mining Company* of Santa Barbara. The orebody consists of mineralized serpentine and shales striking N. 40° W., and dipping 50° E. The vein has a width of about 30 feet. The cinnabar occurs as irregular stringers and pockets of ore along this mineralized belt.

Development consists of seven tunnels totaling over 2,000 feet. The ore was treated in a twelve-pipe retort, two miles below the mine, on Acachuma Creek. A good wagon road runs from Los Olivos to the retort. This property has produced considerable quicksilver, but no accurate production records have been kept. It is said that when the property was operated by the Red Rock Quicksilver Mining Company, the yield was a flask per day. Idle.

Bibl: State Mineralogist Reports VIII, p. 537; XV, p. 746; XVII, p. 389; Bull. 27, p. 196; Bull. 78, p. 150; Reg. of Mines, Santa Barbara Co., 1906. U. S. Geol. Surv. Mon. XIII, p. 382.

Los Prietos Mines (includes the *Milburn-McAvoy* and *Snow Groups*). These mines are eight miles north of Santa Barbara, in the Santa Ynez Mountains north of the Santa Ynez River. The holdings comprise 29 claims located in Secs. 9, 10, 11, 12, T. 5 N., R. 27 W., S. B. M. Owners, *Los Prietos Quicksilver Mines Company*, F. M. Townsend, president; Carl S. Milburn, treasurer; Horace Walley, secretary. Offices, Higgins Building, Los Angeles.

The group of claims is located on a belt of mineralized serpentine which strikes N. 50° W., with a dip 60° to 70° N., and extends along the range for a distance of four miles. The rock formation is sandstone, conglomerate, and shale of the Coast Range, and the strata are folded and faulted in innumerable dips and directions, but have a general easterly strike, and dip to the north. Traversing this belt of sedimentaries is an intrusive belt of serpentine, on either side of which occurs a ledge formation of highly silicified, crushed shale and sandstone, containing cinnabar in variable amounts. Cinnabar is disseminated through the ledge matter, and is said to average about 0.25%. The average lode width is probably not less than 70 feet, but the broken outcrops in many places cover the surface for widths of several hundred feet. The bold yellow-and-brown outcrops stand up prominently from the more eroded inclosing rocks, and are visible for miles. Within this lode occur bodies of cinnabar ore at appreciable distances apart, and three of these ore-areas have so far been partly opened up.

The principal workings are on the Juniper Claim, 800 feet above the river level. These consist of one large and several small opencuts, extending for a length of over 450 feet along the hanging-wall portion of the vein. Tunnels have been driven from three of these open faces, but are partly caved. The main upper crosscut tunnel was in a distance of 100 feet. About 250 feet north and 70 feet below the upper tunnel is another tunnel said to be 100 feet in length. (Caved.) Two hundred and twenty feet west of the main upper tunnel is a tunnel that cut the vein for a distance of 40 feet, showing 20 feet of low-grade ore.

The Milburn-McAvoy workings on the Santa Ynez group of claims are situated about 2½ miles east of the Los Prietos Mine, and to the south of the river. The vein which is 100 feet wide, and well mineralized with cinnabar, boldly outcrops on the western slope of the ridge, about 800 feet above the river, and can be traced for a distance of 2000 feet.

The principal developments on this group of claims consist of a tunnel 45 feet in length on the Ardell claim. About 50 feet in elevation above this tunnel is a tunnel driven along the vein for a distance of 200 feet, most of the distance being in good ore. About 200 feet above this tunnel, near the crest of the hill, is an opencut which shows a broken face about 50 feet wide. This is the footwall section of the vein, which is over 100 feet wide at this point. The whole exposed face is in ore, and the outcrop for a considerable distance is mineralized with cinnabar.

It is said that from samples taken from the different workings on the Santa Ynez group, retort tests on the ore gave 2.3 pounds to 10.5 pounds of mercury per ton; also samples from the Los Prietos Mine workings yielded from 1.2 pounds to 9.4 pounds of mercury per ton. The owners mined and retorted 108 tons of ore, which is said to have yielded an average of 9.2 pounds of mercury per ton during 1918.

A 12-pipe Johnson retort is on the property. With the exception of the annual assessment work, there has been no development since 1918.

Bibl: State Mineralogist Reports VIII, p. 537; X, p. 596; XII, p. 366; XV, pp. 746-748; Bulletin 27, p. 196; Bulletin 78, pp. 150-152. U. S. Geol. Surv. Mon. XIII, p. 382.

NON-METALS

ASPHALT AND BITUMINOUS ROCK.

The county contains many deposits of asphalt and bituminous rock, one of which is being worked on a small scale. The manufacture of asphalt by refining from crude petroleum has entirely replaced its production from natural asphalt and bituminous rock deposits.

The most extensive asphaltum beds in the county are located along the coast line from Carpinteria to Goleta Point, in the Solomon Hills near Graciosa, and on the Rancho La Laguna and Rancho Sisquoc which are south of the Sisquoc River, and east of the town of Sisquoc. Other deposits of minor importance occur in a range of hills lying between the Los Alamos and Santa Ynez rivers, at Point Arguello, near the mouth of Arroyo Hondo, and at other points to Lompoc landing. These deposits have been described in detail in State Mineralogist Reports XIII, pp. 38–42; XV, pp. 730–734.

Higgins Mine is located one mile southeast of Carpinteria Station, between the railroad and the ocean. This is the only deposit that is being worked in the county, being operated only intermittently. The material is being used on the roads in the county. The property was idle when visited. Owner, Mrs. Mary Higgins of Carpinteria. Under lease to A. Sattler and E. P. Stevens of Carpinteria.

The beds of bituminous sands vary in width from 12 to 20 feet, and are overlain by a soft soil overburden four feet thick. It is reported that the material contains from 18% to 20% bitumen.

BARYTES.

Eagle Mine comprises four claims located in Secs. 5 and 6, T. 10 N., R. 30 W., S. B. M., 15 miles northeast of Sisquoc, a station on the Pacific Coast Railroad. Owner, Bean Laughlin of Santa Maria.

The deposit is reached by 20 miles of road and trail from Sisquoc. This road follows La Brea Creek through the Sisquoc Ranch, then by trail, a distance of five miles along the North Fork of La Brea Creek. A vein of pure white barytes is exposed for several hundred feet along the top of the ridge above the North Fork of La Brea Creek, at an elevation of 2800 feet. The vein occurs in a tough gray sandstone, strikes east with the trend of the ridge, and dips steeply north. The vein, where exposed, shows an average width of 25 feet. The barite is pure white in color, and samples are said to have analyzed 97% $BaSO_4$. The only development consists of annual assessment work.

Bibl: State Mineralogist Report XV, p. 734; R. of M. Santa Barbara Co., 1906.

Montecito Barytes Deposit. Barytes occurs on the ridge west of Cold Springs Canyon, two and one-half miles north of Montecito, a station on the Southern Pacific Railroad. Undeveloped.

CHROMITE.

Chromic iron ore occurs in Santa Barbara in the serpentine areas along the hills southwest of Point Sal, and on the southwest slope of the San Rafael Mountains. The only commercial deposits that have as yet been developed are located 12 to 15 miles northeast of Los Olivos. During 1918 considerable tonnage of chrome ore was mined and shipped from this region.

La Laguna Ranch Chrome Deposit. The deposit is situated in the San Rafael Mountain Range, on the ridge between Figueroa and Coralles Creek at an elevation of 2500 feet. It lies on the north corner of the Laguna Ranch, 12 miles northeast of Los Olivos. Owner, *Laguna Ranch Company;* W. H. Bradley, secretary; Pasadena, California.

Lenses of chrome ore that occurred in the serpentine belt were mined by *O'Donnell & Burns Mining Company* during 1918. Idle.

Bibl: State Mineralogist Report XVII, p. 387; Bull. 76, p. 179.

Los Olivos Deposit is located 16 miles northeast of Los Olivos, about one-fourth of a mile north of the Happy Canyon and Acachuma wagon road. Considerable float chrome occurs in this area, and several small lenses of chrome iron were extracted a number of years ago.

O'Donnell & Burns Mining Company of San Francisco, during the early part of 1918 discovered some large lenses of high-grade chromite in T. 8 N., R. 29 & 30 W., S. B. M., northeast of the Laguna Ranch, on government land. These deposits are located 15 miles northeast of Los Olivos. A considerable tonnage of ore was mined and shipped from these deposits in 1918. The ore shipped is said to have carried 45% Cr_2O_3, and some of the cars averaged as high as 53% Cr_2O_3. It is reported that one lens of ore yielded 265 tons averaging better than 45% Cr_2O_3. Developments consist of opencuts and short tunnels. Idle.

CLAY.

Deposits of clay in Santa Barbara County are limited in extent, being mostly low-grade clays suitable for the manufacture of common brick and tile.

One mile south of Carpinteria are extensive beds of diatomaceous and clay shales, which strike N. 70° W. and dip 70° S. The total thickness of these shales is about 200 feet. The Carpinteria Clay Products Company is using this material for the manufacture of brick and tile.

A deposit of montmorillonite occurs on the property of the Carpinteria Clay Products Company. A bed of montmorillonite eight feet thick has been exposed on the north end of the clay pit. It strikes east, and dips 75° south. The *Refineries Clay Company* of Los Angeles formerly had a lease on the deposit. A tunnel was driven 300 feet west on the bed, and considerable tonnage mined and shipped to Los Angeles for use in oil refineries for the refining of petroleum products. It is said that 150 cars of material was shipped in 1924. Montmorillonite (hydrous aluminum silicate) is a colloidal clay, sometimes called 'rock soap' or otaylite, on account of being found and mined near Otay, San Diego County. It is white, brown, and red in color, and contains a large amount of combined water.

Carpinteria Clay Products Company deposit and plant is located west of the Coast Highway, 14 miles north of Ventura, and four miles south of Carpinteria. The deposit is located on the ranch of L. L.

Brentner of Carpinteria, ten acres being under lease to the *Santa Barbara Builders' Supply Company* of Santa Barbara; J. Y. Parker, president; H. H. Young, secretary. Offices, Central Building, Santa Barbara.

The clay beds are nearly vertical, strike east, and have a total thickness of over 200 feet. The clay bank has been opened up for 100 feet in width, and about 75 to 100 feet in height above the floor of the pit. The clay from the opencut is delivered to the plant by means of a drag-line scraper, driven by a gasoline tractor.

The material from the hopper goes to a knife-blade crusher, and is then elevated to a 20-mesh revolving screen, oversize being returned to the crusher, and through-size going to a 14-foot pug-mill. It is then sent to a 12″ auger press. From the auger press it is sent to a wire-cutting brick machine, which has a capacity of 45,000 bricks per 8-hour day. The brick are dried in trays, mostly in the open. Brick and tile are burned in oil-fired field kilns. The total electric power required to operate the plant is 170 horsepower. Other equipment consists of an 80-h.p. boiler and drying sheds. Fifteen men are employed. The products consist of common brick and building tile, varying in color from light cream to pink.

Parker Brick Company's plant is located on West Montecito street, Santa Barbara, one-half mile west of the Southern Pacific Railroad tracks. Owners, *Santa Barbara Builders' Supply Company*, J. Y. Parker, president; H. H. Young, secretary. Offices, Central Building, Santa Barbara.

The deposit is a yellowish, sandy clay, and a very plastic black adobe clay. The yellowish sandy clay is obtained from an opencut on a hill west of the plant, and the black adobe from a pit across the road. The clay from these two openings is mixed in variable quantities in order to prevent cracking from shrinkage. The wet process is used, the green brick being dried under sheds in the open. They are fired in oil-fired field kilns. The brick-making equipment consists of a pug-mill and a press. The products are common red brick, hollow building tile, and drain tile. Twelve to fifteen men are employed.

Toro Canyon Brick and Tile Company's plant is located in Toro Canyon, near Montecito. Owners, *Santa Barbara Builders' Supply Company*, J. Y. Parker, president; H. H. Young, secretary. Offices, Central Building, Santa Barbara.

The deposit is a uniform plastic adobe clay, intermingled with blocks of soft yellow standstone. The clay is mined by Fordson tractors from a shallow side-hill opencut. The brick are dried under sheds, or in the open, and fired in open field kilns. Brick-making equipment consists of a pug-mill and a press. Products are common red brick, red roofing tile, and hollow building tile. Ten men are employed.

DIATOMACEOUS EARTH.

Extensive deposits of diatomaceous earth are located in the foothills along the coast line of Santa Barbara County, extending from Goleta to the Santa Ynez River. The deposits of this material in the vicinity of Lompoc are said to be the most extensive and the purest found in the state. Those that are at present being worked on a commercial scale are located east of San Miguelito Canyon, in the foothills of the Santa Ynez Range. Practically 90% of the output in California comes from Santa Barbara County. These deposits have been thoroughly described by Ralph Arnold and Robert Anderson in U. S. Geological Survey Bulletin 315, 'Diatomaceous Deposits of Northern Santa Barbara County.' The exposures of this material in the hills south of Surf, and along the coast near Goleta, are not as pure as the deposits in the vicinity of Lompoc, and therefore have not been developed to any extent. Diatomaceous earths are very light and extremely porous, chalk-like materials, composed of pure silica, which have been laid down under water, and consist of the remains of microscopic infusoria and diatoms.

The principal commercial use of this material is as an absorbent. It is also employed in the manufacture of scouring soap and polishing powders, for filtration purposes, in making all classes of refractory brick, and as an insulating medium both in heating and refrigeration. It is a first-class nonconductor of heat where high temperatures are employed, such as around steel and gas plants, and power houses. As a nonconductor of heat it has been used alone, or with other materials as a covering for boilers, steam pipes, and safes, and in fire-proof cements. It is also used largely by paint manufacturers as a wood filler.

Celite Products Company (formerly known as *Keiselguhr Company of America*). Offices, 1135 Van Nuys Building, Los Angeles. August Fitger, president; E. W. Birdseys, secretary; Harry S. Thatcher, general manager.

This company owns approximately 2200 acres located on the Rancho Mission Viejo de la Purisima, in T. 6 N., R. 34 W., S. B. M., in the Lompoc Hills, east of San Miguelito Canyon, two miles southeast of Lompoc. The company owns the most extensive deposits of diatomaceous earth in the district, and is the largest producer in California.

Extensive beds of soft, white diatomaceous earth in a very pure state, varying from thinly-bedded to massive, form a capping over the hills. These beds overlay hard brown siliceous shales, are conformable with them, and strike east, dipping 30° south. Approximately 30 quarries have been opened up on the property, at points where the overburden is light.

The character of the material in different parts of the beds varies, and certain parts of the beds are used for specific purposes. The overburden is first removed, and the diatomaceous earth is quarried by means of special channeling machines developed by the company for the purpose.

The largest portion of the product is used for insulating brick, which are sawed on the ground from blocks cut by channeling machines. The material used for grinding is cut by channeling machines, and is then quarried and hauled in wagons to the drying yards. After being sun-dried to reduce the moisture content to about 5 per cent, the material is hauled by motor trucks to the mill at White Hills. The sun-dried brick are hauled to a railroad, which connects the property with the Lompoc Branch of the Southern Pacific Railroad, where the company's warehouses are located. Five hundred men are employed.

Bibl: State Mineralogist Report XV, pp. 737–738; Bull. 38, pp. 293–296. U. S. Bur. of Mines Repts. of Investigations, Serial No. 2431; Rock Products, Vol. XXVI No. 25, Dec. 15, 1923; Cement, Mill and Quarry, Vol. XXII, No. 9, May 5, 1923; A. I. M. E. Bull. 104, Aug. 1915, pp. 1539–1550; E. and M. J. P., Vol. 115, June 30, 1923, pp. 1152–1164. For full detail of the keiselguhr industry see 'Metallurgical and Chemical Engineering.' Vol. XII, No. 2, p. 109.

Featherstone Insulation Company's offices, 611 E. Fourth Street, Los Angeles. Robert Burhous, president; J. C. Specht, vice president; R. W. Cole, secretary; H. T. Carlton, superintendent.

This company owns 1500 acres on the Salsipuedes Ranch, three miles southeast of Lompoc. This deposit of pure white diatomaceous earth, from thin-bedded to massive, occurs in a low range of hills west of the Salsipuedes Creek, and adjoins the property of the Celite Products Company on the east. This property was recently acquired by the company from the Hollister Estate Company of Santa Barbara, and has been under continuous development for the past year.

Beds of Diatomaceous Earth, No. 1 Quarry, Featherstone Insulation Company, Lompoc, Santa Barbara County.

The bed of diatomaceous earth strikes east, and has an average dip of 30° south. Exposures on the west end of the deposit indicate that the bed is over 300 feet thick. The beds of diatomaceous earth overlie hard brown siliceous shales and are conformable with them. At No. 1 quarry, which is located near the top of the ridge, at an elevation of 820 feet, the strata have been exposed by opencut, showing 12 feet of what is termed No. 1 stratum of filtration material; then two feet of flint; then seven feet of good filtration earth; below this stratum is 25 feet of insulation material. Four quarries have been opened up along the strata on different parts of the property. The character of the material varies in different parts of the beds. Only selected areas where the overburden is light are quarried. Also parts of the bed are mined according to whether insulation or filtration material is desired. After cleaning off the overburden, the material is quarried by pick and shovel, and loaded into wagons to be hauled to drying yards. At the present writing the blocks are piled along the sides of the roads for sun drying.

The diatomaceous earth, when quarried, contains about 40% moisture, and after being sun-dried for six weeks, contains about 10% moisture. The dried diatomaceous earth runs 100 cubic feet per ton. Five men are employed getting out insulation material for shipment to the company's plant at Covina. The material is hauled from the deposit by auto truck to Lompoc. The company proposes to install a grinding plant on bottom land near the Las Cruces road, about one-quarter mile from the deposit.

Bibl: State Mineralogist Report XVIII, pp. 366–367.

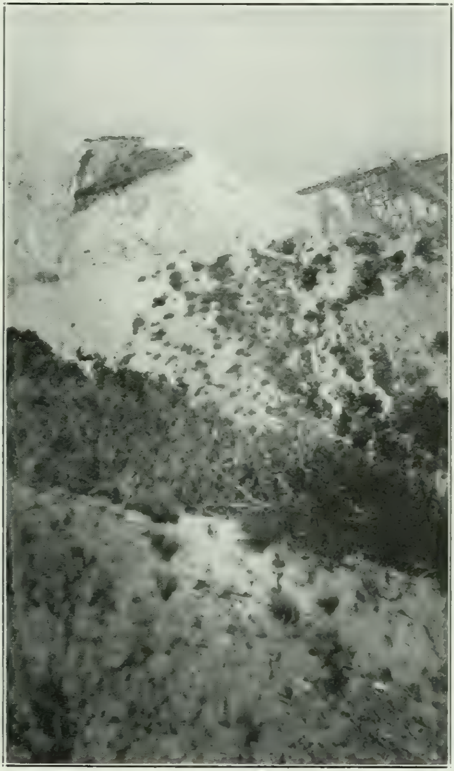
Beds of Diatomaceous Earth, No. 2 Quarry, Featherstone Insulation Company's Deposit, Lompoc, Santa Barbara County.

Guerra Deposit is located five miles east of Lompoc, on the Santa Rita Ranch. Owner, James Guerra of Lompoc. Extensive exposures of flaky white diatomaceous shales occur in the Santa Rita Hills north of the Santa Ynez River.

Bibl: State Mineralogist Report XV, p. 737; Bulletin 38, p. 295.

La Salle Canyon Deposit. This deposit of diatomaceous earth is located on the ridge east of La Salle Canyon, on Tract No. 79 of Lompoc Rancho, three-quarters of a mile south of La Salle, a station on the Lompoc Branch of the Southern Pacific Railroad. Owner, J. P. Donavan of Lompoc. The deposit was formerly worked by the Silica Products Company of Stockton, California.

The beds of diatomaceous earth strike east and dip 65° north. They occur between sandstone and shale, and are about 300 feet thick. About 250 feet above the floor of the canyon, the beds are exposed by a cut 300 feet across the face of the deposit, and 75 feet below the outcrop. Considerable tonnage for insulation material has been mined from the quarry. The material was loaded into cars, then dumped into a two-compartment incline chute. From this chute it was loaded into trucks and hauled to La Salle Station for shipment.



Exposure of Diatomaceous Earth on La Salle Canyon Deposit, La Salle, Santa Barbara County.

The property was under production during 1923 and 1924, but idle at the time of visit.

More Ranch Deposit. John F. More of Goleta, owner. Beds of diatomaceous earth, striking N. 25° E., and dipping 45° to 50° NW., are exposed along the coast at More's Landing, two miles south of Goleta. This deposit has not been developed, and the material is not as pure as that of the Lompoc deposits.

Salsipuedes Ranch Deposit is owned by the *Hollister Estate Company* of Santa Barbara. An undeveloped deposit of white diatomaceous earth occurs on the Salsipuedes Ranch, three miles south of Lompoc. Diatomaceous earth occurs as a capping on the low hills east of the Salsipuedes Creek and the Santa Ynez River. The deposit is not as extensive as that being worked on the same ranch by the Featherstone Insulation Company. Undeveloped.

Sykes Ranch Deposit is located on Lots 155 and 158 of the Lompoc Rancho, one-half mile east of Honda, a station on the Southern Pacific Railroad. Richard Sykes of Montecito, owner. Beds of diatomaceous earth cap a low rounded hill, about one-half mile east of Honda. These beds, which are quite extensive, strike east and dip flatly to the north. The deposit is composed of flaky white diatomaceous earth, and is very uniform in character. Diatomaceous shales are exposed along the coast east of this deposit, and are probably a continuation of the same beds, but do not appear to be of as good quality.

Bibl: State Mineralogist Report XV, p. 738.

Sunnyside Mine is located two miles southeast of Lompoc in a side canyon of San Miguelito Creek, and adjoins the property of the Celite Products Company. Mrs. J. Telford Prewitt of Santa Monica, owner. The deposit occurs along the same beds of diatomaceous earth that are being worked by the Celite Products Company. Considerable development has been done on the property, and some tonnage produced, but now idle.

Bibl: State Mineralogist Report XV, p. 738; Bulletin 38, p. 296.

GYPSUM.

Point Sal Deposit. A deposit of pure white gypsum occurs on the Casmalia Rancho, one-half mile southeast of Point Sal Landing, and five miles northwest of Casmalia. The beds of gypsum occur in clay. The deposit was worked in the early eighties, and a considerable tonnage produced. All workings are caved. Idle.

Santa Barbara Canyon Deposit. A deposit of pure white gypsum occurs on the east side of Santa Barbara Canyon, five miles south of Quartel P. O. in the Cuyama Valley. The outcrop of gypsum is said to be quite extensive, but is inaccessible, being fifty miles from the nearest railroad.

Bibl: State Mineralogist Report XV, p. 737; Bull. 38, p. 288.

LIMESTONE.

J. C. Lind of Lompoc owns a deposit of limestone on the south side of San Miguelito Canyon, six miles southwest of Lompoc, opposite the San Miguelito Canyon deposit. Undeveloped.

Bibl: State Mineralogist Report XV, p. 739; Bull. 38, p. 80.

Thomas W. Moore of Santa Barbara owns a deposit on the Las Positas Ranch, three miles west of Santa Barbara. Tests show this limestone to be of no commercial value, though it is said that the cement used in the construction of the Mission Santa Barbara was made from this limestone.

Bibl: State Mineralogist Report XV, p. 739; Bull. 38, p. 80.

Moraga Ranch Deposit is located in Sec. 4, T. 6 N., R. 20 W., S. B. M., and consists of a fine-grained white limestone which outcrops along a hill in upper Mono Canyon. Years ago some development work was done by the Lomo Blanco Lithographic Stone Company of Los Angeles, but the limestone was found to be unfit for lithographic work, due to the presence of numerous small siliceous veins. Abandoned.

Bibl: State Mineralogist Report XV, p. 739; Bull. 38, p. 80.

San Miguelito Canyon Deposit is located on the north side of San Miguelito Canyon, four miles southwest of Lompoc. Owner, C. S. Larsen, Lompoc. The deposit was formerly operated by the *Union Sugar Company* of Betteravia. All the commercial limestone has been worked out. Idle.

Bibl: State Mineralogist Report XV, p. 741; Bull. 76, pp. 74–75.

MINERAL SPRINGS.

Most of the mineral springs in Santa Barbara County are to be found on the southern slopes of the Santa Ynez Range of mountains. These have been a source of considerable wealth for the county. Practically all the waters produced are marketed for medicinal purposes, as they are said to have great value in the eradication and alleviation of many chronic diseases. These waters compare favorably with some of the best curative waters of Europe.

Burton Mound Sulphur Springs. A number of small sulphur springs, which are visible at low tide, issue from the sands along the beach at Santa Barbara. A large sulphur spring of this group occurs on the site formerly occupied by the Hotel Potter, and the water was utilized in the hotel lobby, but owing to the objectionable odor, the pipe leading from the spring has been sealed for a number of years.

Bibl: State Mineralogist Reports XIII, p. 517; XV, p. 741; U. S. Geol. Surv. Water Supply Paper 338, p. 277.

Bythenia Springs. Owner, J. M. McNulty, Santa Barbara. These springs are located on the Hope Ranch, 3½ miles west of Santa Barbara, and one-half mile northwest of Veronica Springs. Approximate yield is one gallon per minute. The water rights are leased to the *Santa Barbara Mineral Water Company*, Santa Barbara.

Analysis.

By E. W. Hilgard.

Constituents are in grains per U. S. gallon.

Potassium sulphate	2.72
Sodium carbonate	7.27
Magnesium sulphate	1,146.70
Calcium sulphate	111.28
Iron and alumina	1.46
Sodium sulphate	333.10
Sodium chloride	194.47
Magnesian nitrate	278.01
Magnesian carbonate	35.45
Silica	1.64
Total	2,112.10

Bibl: State Mineralogist Report XV, p. 741; U. S. Geol. Surv. Water Supply Paper 338, p. 295.

Las Cruces Hot Springs are situated on the Las Cruces Ranch, four miles north of Gaviota Station. Owner, the *Hollister Estate Company*, Santa Barbara. Four sulphuretted springs ranging in temperature from 67° to 97° F. furnish about 50 gallons of water per minute. This water is piped to the ranch houses for local use.

Bibl: State Mineralogist Reports XIII, p. 345; XV, p. 741. U. S. Geol. Surv. Water Supply Paper 338, p. 68.

Montecito Hot Springs consist of 11 slightly sulphuretted springs which issue from seams in thick bedded sandstone in the steep slopes of the Santa Ynez Mountains, five miles northeast of Santa Barbara. These springs range in temperature from 110° to 120° F., and have a total yield of about 50 gallons per minute. Elevation 1500 feet. Formerly a small resort was conducted on this property, but it is now owned by a private club of Montecito residents who use it as a summer camp. Some of this water is piped to the homes of Montecito residents.

Analysis of water from main spring.

Analyst, Winslow Anderson (1888).

Constituents are in parts per million.

	By weight	Reacting values
Sodium (Na)	110	4.80
Potassium (K)	Trace	Trace
Calcium (Ca)	30	1.52
Magnesium (Mg)	27	2.20
Aluminum (Al)	7.9	.87
Hydrogen (H)	Trace	Trace
Sulphate (So$_4$)	393	8.18
Chloride (Cl)	18	.51
Carbonate (CO$_3$)	21	.70
Arsenate (As O$_4$)	Trace	Trace
Silica (Si O$_2$)	20	.67
Total	626.9	

Bibl: State Mineralogist Reports XII, p. 345; XV, p. 742. U. S. Geol. Surv. Water Supply Paper 338, p. 66.

Moore Spring issues from a soft clay deposit below a limestone ledge in the Veronica Valley, four miles west of Santa Barbara. Owner, Thomas W. Moore, Santa Barbara. (See Limestone, T. W. Moore deposit.)

Analysis.

By Pacific Wassermann Laboratories.

Constituents in grains per U. S. gallon.

Magnesium sulphate	968.25
Calcium sulphate	62.86
Iron and alumina	.35
Sodium sulphate	172.56
Sodium chloride	242.02
Silica	4.26
Sodium nitrate	70.79
Organic and volatile	234.90
Total	1,755.99

Bibl: State Mineralogist Report XV, p. 742.

Pinkham's Santa Barbara Mineral Springs consist of a group of five springs located 2½ miles west of Santa Barbara, on the Hope Ranch. Owner, Pinkham Mineral Springs Company, 1815 Bath Street, Santa Barbara. These springs seep from soft clay shales near the top of a low mesa. Approximately 1500 gallons of this water is bottled yearly.

Analysis.

By J. M. Curtis & Sons.

Constituents are in grains per U. S. gallon.

Potassium sulphate	38.55
Sodium carbonate	8.65
Magnesium sulphate	50.40
Calcium sulphate	32.64
Iron and alumina	2.02
Sodium sulphate	662.34
Sodium chloride	45.42
Magnesian carbonate	90.03
Silica	.87
Lithium chloride	.23
Magnesian chloride	35.40
Calcium chloride	108.03
Calcium phosphate	1.97
Calcium carbonate	1.61
Total	1,149.38

Bibl: Reg. of Mines Santa Barbara Co., 1906; State Mineralogist Report XV, pp. 742, 744; U. S. Geol. Surv. Water Supply Paper 338, pp. 295–296.

San Marcos Cold Springs are owned by the Miramar Hotel Company, and are situated 20 miles northwest of Santa Barbara. Elevation 1100 feet.

Analysis.

By Prof. J. A. Dodge.

Constituents are in grains per U. S. gallon.

Silica	0.35
Sodium chloride	1.54
Sodium carbonate	1.92
Calcium carbonate	3.02
Magnesian carbonate	0.67
Calcium sulphate	5.74
Potash and lithium	Trace
Total	13.24

Bibl: State Mineralogist Report XV, pp. 742–743; U. S. Geol. Surv. Water Supply Paper 338, p. 67.

Veronica Springs. Owner, Veronica Springs Company, Salsipuedes street, Santa Barbara. This group of springs, which is commercially the most important in the county, is located in the hills near the coast, three miles west of Santa Barbara. The water is piped to a storage tank having a capacity of 500,000 gallons, and then siphoned into a 50-barrel tank wagon, and hauled to the bottling plant at Santa Barbara.

Analysis.

By U. S. Bureau of Chemistry.

Constituents are in grains per U. S. gallon.

Magnesium sulphate	1,192.70
Calcium sulphate	69.43
Iron and alumina	.26
Sodium sulphate	344.54
Sodium chloride	233.66
Magnesian nitrate	407.63
Silica	1.81
Magnesian chloride	53.99
Calcium carbonate	145.72
Potassium carbonate	15.71
Total	2,495.45

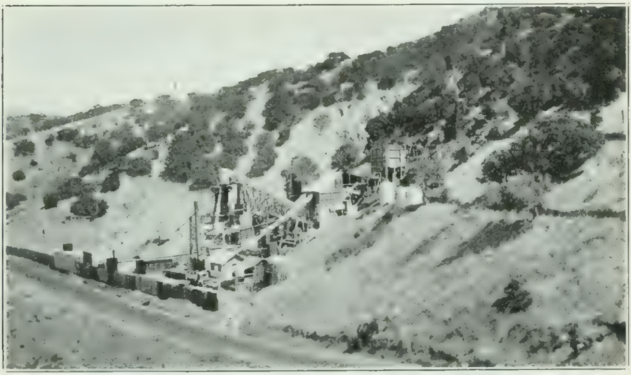
Bibl: State Mineralogist Report XV, pp. 743–744; U. S. Geol. Surv. Water Supply Paper 338, pp. 294–295, 296.

OIL SHALE.

The principal deposits of oil shale in California occur in Santa Barbara and Ventura counties, in and near the present producing oil fields. Oil production in the Santa Maria, Casmalia, and Lompoc oil fields is obtained from this oil shale. The oil shale of California is an oil-saturated diatomaceous shale, and differs both physically and chemically from the shales of other parts of the United States and foreign countries. The most extensive oil shale outcrops in Santa Barbara County are located in the Casmalia Hills, north of Casmalia, and in the Santa Ynez Mountains, north of Santa Barbara.

The extraction of shale oil from the bituminous shales by the destructive distillation of oil shale has not as yet attained any great commercial importance in the United States. Two plants have been in operation in Santa Barbara County on an experimental scale for the past four years, with a commercial production beginning in a small way in 1922. The product, in part, has been sold for utlization as a flotation oil in metallurgical work, and part has been consumed at the plants as fuel. The recovery of the by-product ammonium sulphate is an important feature of the process.

A complete description of the oil shale deposits of Santa Barbara County, and a detailed outline of the different processes in use for the extraction of shale oil are given by F. D. Gore, 'Oil Shale in Santa Barbara County,' in State Mineralogist Report XIX, pp. 211–224, therefore only developments that have taken place since that report was written will be noted.



View of 50-ton Plant and Opencut, Continental Shale Products Company. Schuman, Santa Barbara County.

Continental Shale Products Company, E. M. Markell, president; Harry C. Bell, secretary; Harry C. Ihrig, manager. Offices, Petroleum Securities Bldg., Tenth and Flower streets, Los Angeles. The holdings comprise 40 acres located $2\frac{1}{2}$ miles northeast of Casmalia, and the plant is located one-quarter mile east of Schuman Siding on the Southern Pacific Railroad.

The beds of bituminous shales which are exposed on the property strike northwesterly along the Schuman anticline. In this locality of the inticline, sharp folding has caused fractured zones that extend from the main body of bituminous shale to the surface, and it is here that oil from below has migrated upward, impregnating the upper bodies of shale. Here, not only are the shales saturated with oil, but all the seams and fissures are filled with asphalt, due to the evaporation of the higher volatile substances in the crude oil.

Developments on this deposit consist of two opencuts, also a tunnel driven west 250 feet through the shale bed. The bituminous shales exposed above this tunnel are covered with an overburden of unproductive Monterey shale, which is overlain by a shallow depth of soil. The first experimental apparatus for the extraction of shale oil from the bituminous shales was installed on this property by Dr. David T. Day in 1921.

50-ton Generator, Continental Shale Products Company,
Schuman, Santa Barbara County.

The Day Process is that of destructive distillation and cracking to obtain lighter oil for the purpose of making gasoline and lubricating oils. For a description of the plant and process the reader is referred to State Mineralogist Report XIX, pp. 216–219. The average amount of oil obtained in test runs from the shale was 30 gallons per ton. The crude oil contains from 1% to 3% pyridine bases. This plant is idle, as it was not a commercial success, principally due to mechanical difficulties encountered.

In the early part of 1923, the Day experimental process was replaced by a 50-ton Catlin Retort. The shale mined from the opencut is loaded in small mine cars and trammed to a storage bin having a capacity of 35 tons. The raw shale from the bins is crushed by a set of rolls to about three inches, and is then passed over a 2-inch grizzly to another set of rolls, where it is crushed to 2-inch size. The material is then conveyed to a receiving bin, and then to a shaking screen to eliminate the minus $\frac{1}{2}$-inch product. From the screen it is sent to a bell-shaped hopper over a retort. The shale is then fed to the retort which is 40 feet high and 10 feet in diameter, and arranged for continuous operation. Firing is in an upward direction, but no external heat is necessary, the combustion of the raw material providing all the heat required. The temperature in the retort is maintained at from 1600 to 1750 degrees F. A feature of the operation is the addition of superheated steam. By this process it is reported that over 90% of the total shale oil is recovered. The gravity is about 14° Baumé. The maximum output of the retort is said to be about 100 barrels per day. The plant was not operating when the property was visited, but the company plans to resume operations in the near future.

40-ton Generator, N. T. U. Company, Casmalia, Santa Barbara County.

Bibl: State Mineralogist Report XIX, pp. 216–219.

The *N. T. U. Company.* D. J. L. Davis, president and general manager; M. A. J. Davis, secretary; G. W. Wallace, consulting engineer; J. E. Quinlan, superintendent. Offices, 2201 Gotham National Bank Building, 1819 Broadway, New York.

This company has a lease on 1600 acres on W. C. Stokes' Ranch, located six miles west of Orcutt, and two miles north of Casmalia. Extensive beds of bituminous shale occur on this property, and follow the Schuman anticline in a northwesterly direction to Corralitos

Canyon. These beds are overlain by an overburden of diatomaceous shale and soil varying in thickness from 10 to 15 feet. About 1100 feet northwest of the plant, the deposit has been developed by an opencut 60 feet in width and height, which enters the beds of shale for a distance of 100 feet. The maximum height of outcrops above the present quarry level is about 240 feet.

After being mined from the quarry, the rock is loaded by hand into cars, and trammed to a hopper at the crushing and loading plant. The material from the hopper is carried by bucket elevator to a roll type of crusher, and is crushed to 2½-inch size. The crushed shale then drops direct from the crusher into a 40-ton steel car. The car of crushed shale is then lowered by gravity down a 5 per cent grade, over a standard gauge railway, a distance of 1100 feet, directly over the generator for charging. This car contains a charge of 40 tons of shale, the capacity of the generator. After discharging its load, the steel car is hauled back to the loading plant by means of a cable attached to a 25-h.p. electric hoist.

Process. The generator used is a cylindrical retort of 40 tons capacity, having an inclosed grate at the bottom connected with a suction fan, which creates a down-draft within the retort, passing out through the grate and a set of condensor tubes and scrubbers.

The operation of the retort is as follows: The generator is filled with crushed shale, and then a fire is started on the top of the charge by means of wood for fuel and some crude oil. The suction fan is then turned on, drawing the heat of this combustion down through the charge of shale. When the shale at the top of the charge is ignited, the cover of the generator is closed so that only enough air is admitted to support slow combustion, which is allowed to continue only on the fixed carbon in the shale. The volatile matter is carried off at a comparatively low temperature by the hot flue gases, and is caught in passing through the water-cooled condensor and scrubbers. A part of this flue gas is mixed with air entering the generator and serves to increase the volume of the gases passing through the charge without increasing the combustion. As the distillation proceeds, the fire zone gradually moves down through the charge, driving off the oil.

A sudden rise in temperature at the grate indicates completion of the distillation. The blower is then shut down and the entire grate is rolled back by means of a motor-operated screw, allowing the spent shale to drop clear of the retort while hot. The grate is then returned to its position, and the retort is ready for another charge.

Complete distillation takes place in approximately 18 hours. The average run of shale treated by this process is said to be between 30 and 35 gallons to the ton. The recovery made is reported to be 90 per cent of the shale oil. The gravity of the oil is about 14 degrees Baumé.

Plant and equipment are operated by electric power furnished by the San Joaquin Light and Power Company. The company is at present installing three additional generators, each of 40-ton capacity, bringing the total capacity up to 160 tons.

The company built an experimental plant of 20-ton capacity in the early part of 1922 to develop and perfect a process utilizing internal combustion for the distillation of oil shale. As a result of the operation of this experimental plant, the company decided to install a commercial unit, and expect to have this 160-ton plant under operation during the latter part of 1925. The crude oil produced is useful for flotation oil, and it yields readily to standard cracking processes. Eight men are employed at the mine and crushing plant, and it will require 18 to 20 men to operate the generator plant.

Bibl: State Mineralogist Report XIX, pp. 219–224.

Oil Shale Deposits of Santa Ynez River Region. Carl L. Milburn and W. S. Rosecrans of Los Angeles have filed on 5000 acres of land which was located under the oil leasing act in T. 5 N., R. 27 W., about 25 miles from the town of Santa Ynez, up the Santa Ynez River, and 12 miles north of Santa Barbara. In this region a belt of Monterey shale outcrops about the flanks of the large anticline, and extends along the river westward from the old quicksilver furnace in Sec. 3, T. 5 N., R. 27 W. It consists of thinly bedded, light-colored organic shale, quite uniformly saturated with oil. This belt of shales strikes southeast through Secs. 4, 10, 11 and 13, following the Santa Ynez fault. Samples taken from opencuts made along this belt of bituminous shales are reported to show about 40 gallons per ton of shale. The deposit is undeveloped.

Bibl: Geology of a part Santa Ynez River District, Santa Barbara County, Report of Geology Department University of California, Vol. 12, No. 1, pp. 1–121, Nov. 20, 1919.

PETROLEUM AND NATURAL GAS.

Santa Barbara County ranks sixth in the state in the production of petroleum, having produced in 1923 a total of 3,061,947 barrels, valued at $2,394,433. The production of natural gas for the year 1923 was 1,612,287 thousand cubic feet, valued at $172,725.

The oil-producing districts of the county are Casmalia, Cat Canyon, Lompoc, Santa Maria, and Summerland fields, which are described in the various bulletins issued by the State Mining Bureau on the petroleum industry of California, so that no further description will be attempted in this report.

Bibl: State Mineralogist Reports VII, p. 89; XII, p. 537; XIII, p. 582; Bulletins 11, 19, 32, 63, 89; Summary of Operations California Oil Fields.

SANDSTONE.

Extensive deposits of tough gray sandstone, suitable for building purposes, are located in this county, but the increased use of concrete in the construction of buildings has almost entirely displaced the sandstone industry, so that very little building stone is now quarried. The principal deposits of sandstone that have been quarried to any extent are located in Mission and Refugio canyons. The high ridge of the Santa Ynez Mountains from Point Concepcion eastward is formed by a great monocline of sandstone that dips toward the ocean on the south. On the range back of Santa Barbara this sandstone is very massive and dips north.

Erickson Quarry is located in T. 9 N., R. 34 W., S. B. M.; J. B. Arellanes of Santa Maria, owner. Some of this rock near Casmalia Station was used for masonry work on the railroad years ago.

Bibl: State Mineralogist Report XIII, p. 637; R. of M. Santa Barbara County, 1906; Bulletin 69, p. 133.

Hogan Quarry is located in Sec. 2, T. 4 N., R. 27 W., S. B. M., three miles north of Santa Barbara, in Sycamore Canyon. Owner, T. M. Hogan, 826 Orange avenue, Santa Barbara. This deposit consists of beds of hard gray sandstone a couple or hundred feet thick, outcropping in Sycamore Canyon for several hundred feet.

Bibl: R. of M. Santa Barbara County, 1906.

Mission Canyon Deposit is two miles north of Santa Barbara. This consists of large boulders of hard, fine-grained buff-colored sandstone, which was quarried by hand years ago by the Franciscan monks, for use about the Santa Barbara Mission.

Bibl: Bulletin 38, p. 133.

Orella Estate Quarry is located in Sec. 12, T. 5 N., R. 31 W., S. B. M., at the head of Refugio Canyon, eight miles north of Orella Station on the Southern Pacific Railroad.

Bibl: Bulletin 38, p. 133.

STONE INDUSTRY.

Only a limited supply of rock and gravel suitable for concrete construction is to be found in the immediate vicinity of the principal cities and towns of the county. During the early part of 1925 the city of Santa Barbara suffered severe damage by earthquake, and a great number of the large buildings in the business section were so badly damaged that they will have to be rebuilt. Therefore there will be an increased demand for building materials, in which large amounts of crushed rock, gravel, and sand will be required.

The following individuals and companies were producers during 1924:

Frank A. Gates of Santa Maria, operating a gravel plant located one-half mile south of Sisquoc, on the Santa Maria River. Materials produced consist of crushed rock, gravel, and sand; also manufacturing cement for irrigation pipe.

Mission Santa Barbara, Santa Barbara.
P. C. Schuck, Superintendent of Streets, Lompoc.
Veronica Stone Company, Santa Barbara.

OIL FIELD DEVELOPMENT OPERATIONS.

By R. D. Bush, State Oil and Gas Supervisor.

From July 19, 1925, to and including October 31, 1925, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
ALAMEDA COUNTY					
Calhona Oil Corp.	9	35	3	1	Alameda County
FRESNO COUNTY:					
Mohawk Oil Co.	34	20	16	1	Coalinga
Pacific Oil Co.	25	20	14	79	Coalinga
Pacific Oil Co	25	20	14	100	Coalinga
Pacific Oil Co.	25	20	14	101	Coalinga
Pacific Oil Co.	25	20	14	136	Coalinga
Penn-Coalinga Petroleum Co.	1	20	14	16	Coalinga
Zier Oil Co	1	20	14	N-4	Coalinga
Zier Oil Co.	1	20	14	N-5	Coalinga
KERN COUNTY:					
Bear State Oil Co.	30	28	21	14	Belridge
Lacy-Esper Petroleum Co.	18	29	22	1	Belridge
Myrtle E. Oil Co.	8	29	21	1	Belridge
Devils Den Products Co.	24	25	18	1	Devils Den
Belridge Oil Co.	34	30	24	8	Elk Hills
Belridge Oil Co.	34	30	24	10	Elk Hills
Belridge Oil Co.	34	30	24	12	Elk Hills
Belridge Oil Co.	34	30	24	14	Elk Hills
Belridge Oil Co.	34	30	24	16	Elk Hills
Belridge Oil Co.	34	30	24	18	Elk Hills
Chas. Differding, Trustee	26	30	24	1	Elk Hills
Elk Hills Petroleum Co.	34	30	24	1	Elk Hills
Elk Hills Petroleum Co.	34	30	24	4	Elk Hills
Elk Hills Petroleum Co.	34	30	24	5	Elk Hills
Elk Hills Petroleum Co.	34	30	24	6	Elk Hills
Elk Hills Petroleum Co.	34	30	24	7	Elk Hills
Elk Hills Petroleum Co.	34	30	24	8	Elk Hills
Elk Hills Petroleum Co.	34	30	24	9	Elk Hills
Gross Drilling Co.	26	30	24	2	Elk Hills
Gross Drilling Co.	26	30	24	3	Elk Hills
North Elk Oil Co.	22	30	24	1	Elk Hills
Pacific Oil Co.	27	30	24	18	Elk Hills
Pacific Oil Co.	27	30	24	20	Elk Hills
Pacific Oil Co.	27	30	24	25	Elk Hills
Pacific Oil Co.	27	30	24	26	Elk Hills
Pacific Oil Co.	35	30	24	82	Elk Hills
Pacific Oil Co.	35	30	24	122	Elk Hills
Pan American Petroleum Co.	3	31	24	Crampton K 2	Elk Hills
Pan American Petroleum Co.	3	31	24	Crampton K 3	Elk Hills
Union Oil Co.	26	30	24	Elk Hills 12	Elk Hills
The United Oil Co.	22	30	24	Slater 1	Elk Hills
Boston Petroleum Co.	20	28	28	25	Kern River
California Mutual Finance Corp.	2	29	28	12	Kern River
George F. Getty, Inc.	14	28	27	Lehnardt 2	Kern River
Gray Heirs	11	29	28	3	Kern River
Petroleum Securities Co.	22	28	27	2	Kern River
Petroleum Securities Co.	22	28	27	3	Kern River
Richards Oil Co.	8	29	28	12	Kern River
F. G. Wagner	34	28	28	3	Kern River
Ridge Oil Co.	13	30	21	1	McKittrick
Washington Petroleum Corp.	8	30	22	5	McKittrick
Balboa Oil Co.	24	31	23	42	Midway
Balboa Oil Co.	24	31	23	43	Midway
C. C. M. O. Co.	27	31	22	4	Midway
C. C. M. O. Co.	35	31	22	14	Midway
C. C. M. O. Co.	22	31	22	35	Midway
California Petroleum Corp.	34	32	24	Dorothy 4	Midway
California Petroleum Corp.	34	32	24	Dorothy 6	Midway
E. & M. Oil Co., Inc.	10	31	22	2-A	Midway
Gilmore Oil Co.	27	31	22	4	Midway
Gralan Oil Co.	4	32	23	5	Midway
Honolulu Consolidated Oil Co.	4	32	24	23	Midway
Honolulu Consolidated Oil Co.	4	32	24	24	Midway
Honolulu Consolidated Oil Co.	4	32	24	43	Midway
Honolulu Consolidated Oil Co.	4	32	24	44	Midway
Honolulu Consolidated Oil Co.	4	32	24	53	Midway
Honolulu Consolidated Oil Co.	2	32	24	57	Midway
Honolulu Consolidated Oil Co.	4	32	24	63	Midway
Honolulu Consolidated Oil Co.	2	32	24	68	Midway
Honolulu Consolidated Oil Co.	8	32	24	68	Midway
Honolulu Consolidated Oil Co.	2	32	24	77	Midway

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
Midland Oilfields Co., Ltd.	34	31	24	6	Midway
Midland Oilfields Co., Ltd.	24	31	23	18	Midway
Midland Oilfields Co., Ltd.	34	31	24	B-3	Midway
North American Oil Cons.	32	31	24	5	Midway
North American Oil Cons.	32	31	24	25	Midway
North American Oil Cons.	30	31	24	26	Midway
North American Oil Cons.	30	31	24	27	Midway
North American Oil Cons.	30	31	24	32	Midway
North American Oil Cons.	30	31	24	35	Midway
Pacific Oil Co.	5	32	24	11	Midway
Pacific Oil Co.	19	31	24	18	Midway
Pacific Oil Co.	19	31	24	20	Midway
Pacific Oil Co.	33	31	24	26	Midway
Pacific Oil Co.	3	32	24	37	Midway
Pacific Oil Co.	5	32	24	65	Midway
The Southwestern Petroleum Co.	2	31	22	8	Midway
The Springs Co	28	31	24	28-1	Midway
Surprise Oil Co.	36	32	23	11	Midway
The United Oil Co.	20	31	23	1	Midway
The United Oil Co.	19	31	23	Calidon 5	Midway
Valley Oil Co.	14	31	22	4	Midway
Western Production Co.	21	31	22	4	Midway
El Dora Oil Co.	32	12	23	8	Sunset
General Petroleum Corp.	32	12	23	10	Sunset
General Petroleum Corp.	32	12	23	10-A	Sunset
General Petroleum Corp.	32	12	23	10-B	Sunset
General Petroleum Corp.	6	11	23	14-B	Sunset
Lewis Petroleum Co.	34	12	24	G-M 12	Sunset
Midland Oilfields Co., Ltd.	32	12	23	1	Sunset
Midland Oilfields Co., Ltd.	32	12	23	7	Sunset
Midland Oilfields Co., Ltd.	32	12	23	Maricopa Star 1	Sunset
Midway Oil Co.	27	12	24	1	Sunset
Pacific Oil Co	25	12	24	15	Sunset
Pacific Oil Co.	32	12	23	5-A	Sunset
Standard Oil Co.	36	12	24	M. J. M. & M. 60	Sunset
The United Oil Co.	32	12	23	Transport 1	Sunset
Hastain & Purman, Inc.	1	29	20	1	Temblor
Standard Oil Co.	27	11	20	Kern Co. Lease 2 16	Wheeler Ridge
John K. Porter	32	26	28	1	Kern County
Standard Oil Co.	35	26	19	Cahn Test 1	Kern County
Standard Oil Co.	27	28	22	Miller & Lux Option 2	Kern County
LOS ANGELES COUNTY:					
Shell Co.	34	3	13	Reyes 30	Dominguez
Shell Co.	34	3	13	Reyes 31	Dominguez
Associated Oil Co.	7	2	14	Vickers 19	Inglewood
Associated Oil Co.	7	2	14	Vickers 21	Inglewood
Associated Oil Co.	7	2	14	Vickers 26	Inglewood
Mohawk Oil & Gas Syn.	7	2	14	5	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 12	Inglewood
Pacific Oil Co.	8	2	14	Baldwin 16	Inglewood
Pacific Oil Co.	8	2	14	Baldwin 18	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 22	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 24	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 25	Inglewood
Pacific Oil Co.	8	2	14	Baldwin 26	Inglewood
Pacific Oil Co.	8	2	14	Baldwin 27	Inglewood
Petroleum Securities Co.	8	2	14	Cone 14	Inglewood
Petroleum Securities Co.	8	2	14	Cone 15	Inglewood
Petroleum Securities Co.	8	2	14	Lloyd 6-A	Inglewood
Producers Holding Co.	7	2	14	1	Inglewood
Shell Co.	8	2	14	Rindge 14	Inglewood
Smith, Rucker, Wilson	19	2	14	1	Inglewood
Standard Oil Co.	8	2	14	L. A. Invest. 1 24	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 25	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 26	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 27	Inglewood
Standard Oil Co.	8	2	14	L. A. Invest. 1 28	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 29	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 30	Inglewood
Standard Oil Co.	8	2	14	L. A. Invest. 1 31	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 32	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 33	Inglewood
Standard Oil Co.	21	2	14	L. A. Invest. 2 6	Inglewood
Standard Oil Co.	16	2	14	Stocker 2	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 16	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 17	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 18	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 19	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 8	Inglewood
Barry Oil Assn.	13	4	13	Leavell 1	Long Beach

Company	Sec	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Burke Oil Co.	24	4	13	1	Long Beach
Burke Oil Co.	24	4	13	2	Long Beach
Bush-Voorhis Oil Co.	24	4	13	14	Long Beach
California Petroleum Corp.	19	4	12	Fields 17	Long Beach
E. E. Combs Business Trust No. 3	24	4	13	E. E. Combs 3	Long Beach
Cook, Miller & McKinnis	13	4	13	2	Long Beach
Craig, Burns & Co., Inc.	13	4	13	4	Long Beach
Craig, Burns & Co., Inc.	13	4	13	Sneden 1	Long Beach
Joseph B. Dabney	24	4	13	1	Long Beach
A. J. Delaney	13	4	13	2	Long Beach
A. J. Delaney	13	4	13	3	Long Beach
A. J. Delaney	13	4	13	4	Long Beach
A. J. Delaney	19	4	12	Delaney 1	Long Beach
Featherstone & Preston	24	3	13	Featherstone 8	Long Beach
Featherstone & Preston	24	4	13	Featherstone 9	Long Beach
Featherstone & Preston	24	4	13	Featherstone 10	Long Beach
Featherstone & Preston	24	4	13	Featherstone 11	Long Beach
Featherstone & Preston	24	4	13	Featherstone 12	Long Beach
Walter H. Fisher Corp.	30	4	12	5-B	Long Beach
Nathan W. Hale	18	4	12	1	Long Beach
Nathan W. Hale	9	4	12	Hale McAdoo 1	Long Beach
Herwick Interests	24	4	13	Herwick 24	Long Beach
R. E. Ibbetson Drilling Co.	24	4	13	4	Long Beach
R. E. Ibbetson Drilling Co.	13	4	13	5	Long Beach
A. T. Jergins Trust	19	4	12	17-A	Long Beach
Geo. W. Johnson	13	4	13	1	Long Beach
Geo. W. Johnson	13	4	13	2	Long Beach
Kohlbush & Johnston	13	4	13	Kohlbush & Johnston 1	Long Beach
Lake View No. 2 Oil Co.	13	4	13	1	Long Beach
Macmillan Petroleum Products Co.	13	4	13	4	Long Beach
McKeon Drilling Co., Inc.	24	4	13	McKeon O'Donnell 1	Long Beach
H. W. Nall	24	4	13	Kathryn F.	Long Beach
J. E. O'Donnell	24	4	13	O'Donnell 44	Long Beach
J. E. O'Donnell	19	4	12	O'Donnell 45	Long Beach
J. E. O'Donnell	18	4	12	O'Donnell 46	Long Beach
J. E. O'Donnell	19	4	12	O'Donnell 47	Long Beach
J. E. O'Donnell	18	4	12	O'Donnell 48	Long Beach
Progressive Burnett Syn.	30	4	12	3	Long Beach
Rainbow Petroleum Co.	19	4	12	3	Long Beach
W. R. Ramsey	28	4	12	B-6	Long Beach
W. R. Ramsey	28	4	12	B-7	Long Beach
Richmond Oil Co.	19	4	12	2	Long Beach
Ring Petroleum Corp.	13	4	13	Grant 1	Long Beach
San Martinez Oil Co.	29	4	12	Fry 3	Long Beach
San Martinez Oil Co.	29	4	12	Greene Comm. 3	Long Beach
J. T. Shepard	24	4	13	1	Long Beach
Sunset Petroleum Co.	24	4	13	1	Long Beach
Sunset Petroleum Co.	19	4	12	2	Long Beach
Umpire Petroleum Corp.	13	4	13	5	Long Beach
Umpire Petroleum Corp.—Apex Petroleum Corp.	24	4	13	4	Long Beach
The United Oil Co.	13	4	13	Stewart 1	Long Beach
H. L. Whiston	19	4	12	1	Long Beach
R. Whiston	24	4	13	McMillan 1	Long Beach
Young & Theriot	13	4	13	Nigus 1	Long Beach
Howard Zellers	13	4	13	1	Long Beach
McGinley Oil Co.	6	2	11	23	Montebello
St. Helens Riverside Properties	2	2	12	Monterey 10	Montebello
Standard Oil Co.	6	2	11	Baldwin 64	Montebello
Superior Oil Co.	6	2	12	Anderson A-1	Montebello
Wm. G. McAdoo, Jr.	6	3	15	1	Newhall
G. S. Willhoite & A. G. McCoy	6	3	15	1	Newhall
Barnsdall Oil Co.	18	3	13	O'Dea 4	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 6	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 7	Rosecrans
Barnsdall Oil Co.	20	3	13	Rosecrans 7	Rosecrans
Walter H. Fisher Corp.	7	3	13	13	Rosecrans
B. E. Gerner	7	3	13	Bud Gerner 2	Rosecrans
Henderson Petroleum Corp.	7	3	13	Athens 3	Rosecrans
Hitchcock & Ort	7	3	13	H. & O. 14	Rosecrans
Marine Corp.	7	3	13	39	Rosecrans
Star Petroleum Co.	18	3	13	Shoemaker 2	Rosecrans
Union Oil Co.	18	3	13	Howard Park 17	Rosecrans
Union Oil Co.	18	3	13	Howard Park 25	Rosecrans
Union Oil Co.	18	3	13	Howard Park 26	Rosecrans
Union Oil Co.	18	3	13	Rosecrans 6	Rosecrans
Union Oil Co.	18	3	13	Trust 4	Rosecrans
Ambassador Petroleum Co.	5	3	11	Baker 6	Santa Fe Springs
Bandini Petroleum Co.	5	3	11	Off 5	Santa Fe Springs
Bandini Petroleum Co.	5	3	11	Off 6	Santa Fe Springs

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
California Petroleum Corp	5	3	11	Wickman 2	Santa Fe Springs
C. C. M. O. Co	9	4	14	Del Amo 28	Torrance
C. C. M. O. Co	9	4	14	Del Amo 33	Torrance
C. C. M. O. Co	9	4	14	Del Amo 35	Torrance
C. C. M. O. Co	16	4	14	Del Amo 38	Torrance
C. C. M. O. Co	9	4	14	Del Amo 41	Torrance
C. C. M. O. Co	16	4	14	Del Amo 43	Torrance
C. C. M. O. Co	9	4	14	Del Amo 47	Torrance
C. C. M. O. Co	9	4	14	Del Amo 53	Torrance
C. C. M. O. Co	8	4	14	Del Amo 87	Torrance
C. C. M. O. Co	8	4	14	Del Amo 93	Torrance
C. C. M. O. Co	8	4	14	Del Amo 99	Torrance
California Petroleum Corp	5	4	14	Redondo Imp. Co. 4	Torrance
Harry Crinklaw	17	4	13	1	Torrance
Wm. E. Garner	18	4	13	1	Torrance
General Petroleum Corp	8	4	14	Carson 11	Torrance
General Petroleum Corp	8	4	14	Carson 12	Torrance
R. & D. Oil Co	9	4	14	1	Torrance
Shell Co	9	4	14	Redondo Comm. 5	Torrance
Shell Co	9	4	14	Redondo Comm. 6	Torrance
Shell Co	9	4	14	Torrance 6	Torrance
Shell Co	9	4	14	Torrance 5	Torrance
Shell Co	9	4	14	Torrance 7	Torrance
Standard Oil Co	22	4	14	Marble Lease 2 5	Torrance
California Petroleum Corp	17	2	11	Rideout Hamburg 2	Whittier
California Petroleum Corp	17	2	11	Seward-Rideout 3	Whittier
California Petroleum Corp	17	2	11	Witte Vining 2	Whittier
Central Oil Co. of Los Angeles	23	2	11	76	Whittier
Bardeen Oil Co	9	2	10	3	Los Angeles County
Elbe Oil Land Development Co.	13	2	15	6	Los Angeles County
A. T. Jergins Trust	34	4	14	Palos Verdes 1	Los Angeles County
Marland Oil Co	2	5	12	Bixby 1	Los Angeles County
Milham Exploration Co	11	4	16	Conroy 1	Los Angeles County
Petroleum Securities Co	35	4	14	Narbonne 1	Los Angeles County
Shell Co	36	2	10	Menchego 1-A	Los Angeles County
W. W. Stabler	18	5	16	Jenkins 1	Los Angeles County
Thedieck, Brown & Manson	11	4	12	1	Los Angeles County
ORANGE COUNTY:					
Birch Oil Co	2	3	10	2-A	Brea Olinda
Brea Canon Oil Co	2	3	10	38	Brea Olinda
C. C. M. O. Co	9	3	9	98	Brea Olinda
Fullerton Oil Co	2	3	10	20	Brea Olinda
Central Oil Co	2	6	11	Hesse 1	Huntington Beach
Richland Oil Co	2	6	11	1	Huntington Beach
Southern California Drilling Co.	2	6	11	Granis 1	Huntington Beach
Standard Oil Co	34	5	11	Bolsa 22	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B 3	Huntington Beach
Standard Oil Co	2	6	11	Huntington B 36	Huntington Beach
Standard Oil Co	4	6	11	Huntington B 38	Huntington Beach
Standard Oil Co	4	6	11	Huntington B 39	Huntington Beach
Standard Oil Co	34	5	11	Jones Comm. 5	Huntington Beach
Interstate Oil Corp	21	6	10	Heights 2	Newport
Interstate Oil Corp	21	6	10	Mesa 3	Newport
Julian Petroleum Corp	17	6	10	Hartley 1	Newport
Julian Petroleum Corp	21	6	10	Mesa 2	Newport
Julian Petroleum Corp	21	6	10	Mesa 3	Newport
Marine Corp	14	6	10	Costa Mesa 53	Newport
J. J. Rekar	21	6	10	1	Newport
Sunland Oil Assn	21	6	10	1	Newport
Western Oil & Refining Co	4	6	10	Adams 1	Newport
Western Pacific Oil Co	27	6	10	1	Newport
Standard Oil Co	29	3	9	Kraemer No. 2 20	Richfield
Union Oil Co	29	3	9	Coyle & Bogue 4	Richfield
Frank R. Anderson, Geo. A. Parsons, C. E. Kelly	13	8	8	1	Orange County
Quadri Petroleum Co.	7	3	8	1	Orange County
Shell Co	30	5	10	Von Schriltz 1	Orange County
Henry Whitcup	27	6	10	1	Orange County
RIVERSIDE COUNTY:					
Beaumont Riverside Oil Syn.	18	3	1	1-A	Riverside County
A. W. Duncan	17	4	6	1	Riverside County
SAN BENITO COUNTY:					
Reorganized Homestake Divide Mining Co.	8	17	11	1	San Benito County

Company	Sec.	Twp	Range	Well No.	Field
SAN BERNARDINO COUNTY:					
Thomas C. Bannon	32	2	8	1	San Bernardino Co.
Zenith Oil Co.	32	2	8	2	San Bernardino Co.
SAN LUIS OBISPO COUNTY:					
A. J. Crose	34	28	13	1	San Luis Obispo Co.
Fox & McCoy	Lot 133	27	11	Walkin 18	San Luis Obispo Co.
Livermore & Phelps	8	32	22	1	San Luis Obispo Co.
Carter Mullaly	7	32	22	1	San Luis Obispo Co.
Paso Robles Gas Co.	19	26	12	1	San Luis Obispo Co.
SANTA BARBARA COUNTY:					
Pan American Petroleum Co.	..	9	34	Soladino 25	Casmalia
Brooks Oil Co	32	9	32	6	Cat Canyon
Brooks Oil Co.	32	9	32	6-A	Cat Canyon
Brooks Oil Co.	32	9	32	7	Cat Canyon
Palmer Union Oil Co.	29	9	32	Stendell 6	Cat Canyon
R. & G. Oil Co.	30	9	32	5	Cat Canyon
TULARE COUNTY:					
Hub Oil Co.	27	22	27	2	Tulare County
VENTURA COUNTY:					
Montebello Oil Co.	4	3	19	Shiells 119	Bardsdale
Montebello Oil Co.	4	3	19	Shiells 120	Bardsdale
C. A. Harding, Trustee	34	2	20	14	Conejo
C. A. Harding, Trustee	34	2	20	15	Conejo
C. A. Harding, Trustee	34	2	20	16	Conejo
C. A. Harding, Trustee	34	2	20	17	Conejo
C. A. Harding, Trustee	34	2	20	18	Conejo
C. A. Harding, Trustee	34	2	20	19	Conejo
C. A. Harding, Trustee	33	2	20	47	Conejo
C. A. Harding, Trustee	33	2	20	48	Conejo
C. A. Harding, Trustee	33	2	20	49	Conejo
C. A. Harding, Trustee	33	2	20	50	Conejo
C. A. Harding, Trustee	33	2	20	51	Conejo
C. A. Harding, Trustee	33	2	20	52	Conejo
Surprise Oil Syn.	33	2	20	7	Conejo
Surprise Oil Syn.	33	2	20	8	Conejo
Moherb Oil Co.	35	4	18	1	Piru
Schell & Jennings	32	4	18	9	Piru
F. G. Warner	36	4	18	Warner 1	Piru
Hoyt S. Gale	29	2	21	Beardsley 1	Simi
Oak Ridge Oil Co.	13	3	21	Harvey 16	South Mountain
Associated Oil Co.	27	3	23	Lloyd 11	Ventura
Associated Oil Co.	27	3	23	Lloyd 20	Ventura
Associated Oil Co.	27	3	23	Lloyd 26	Ventura
Associated Oil Co.	26	3	23	Lloyd 101	Ventura
C. C. M. O. Co	22	3	23	Hobson 1-A	Ventura
A. F. Calhoun	9	3	23	1	Ventura
J. A. Hess	33	4	23	18	Ventura
J. A. Hess	34	4	23	4-A	Ventura
Shell Co.	29	3	23	Taylcr 10	Ventura
Standard Oil Co.	17	2	22	Argabrite 1	Ventura County

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

It is anticipated that these special articles will cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

DIRECTORY OF CALIFORNIA FOUNDRIES.

The result of the tests on California Foundry Sands, carried out by the Joint Committee on Molding Sand Research and the Engineering Division of the National Research Council, were published in 'Mining in California,' issue of April, 1925.

In connection with this work, a list of the foundrymen of each state was compiled for the use of the State Geologist or other cooperating state official.

The list of California foundries has just been furnished the State Mining Bureau by the American Foundrymen's Association, and is published herewith in the hope that it will be of benefit to producers of molding sand and other foundry supplies.

California Foundries.

Alameda:
  McKinney and Spies, 2319 Clement St.
Alhambra:
  Braun, C. F., 1200 S. Fremont St.
  Southern California Foundry Co., 1170 Westminster Ave.
Angels Camp:
  Angels Iron Works.
Bakersfield:
  Bakersfield Iron Works.
Bay Point:
  Bay Point Foundry Co.
Berkeley:
  Berkeley Brass Foundry Co., 2629 Seventh St.
  Greene Steel Castings Co., 1302 Second St.
  Macaulay Foundry Co., H. C., Sixth and Carlton Sts.
  Oakland Furnace and Foundry Co., Fourth and Bancroft Way.
Burbank:
  American Aluminum Metal Products Co.
  Moreland Motor Truck Co.
Chico:
  Chico Iron Works, 744 Broadway.
Coalinga:
  Bunting Iron Works.
Emeryville:
  Connelley Brass Foundry, E. R., 4064 Holden St.
  Judson Manufacturing Co.
  Western Aluminum Manufacturing Co., Forty-fifth and Holden Sts.

- Eureka:
  - Acme Foundry, 268 Hillsdale St.
  - New Eureka Foundry, First and S Sts.
- Fresno:
  - Burnett Iron Works, Inc., J. H.
  - Federal Foundry Co., 1939 Webster St.
  - Lisenby Manufacturing Co., Kern and Angus Sts.
  - Mathews Foundry Co.
  - Valley Foundry and Machine Works, 710 H St.
- Grass Valley:
  - George Bros.
  - Taylor's Foundry and Engineering Co.
- Long Beach:
  - Long Beach Iron Works, 2220 W. Anaheim St.
- Los Angeles:
  - "A" Brass Foundry, 2046 E. Vernon Ave.
  - Alloy Steel and Metal Co., Fifty-fifth and Alameda Sts.
  - Aluminum Castings Co., 1724 Naud St.
  - American Brake Shoe and Foundry Co. of California, 1170 E. Thirty-second St.
  - American Foundry Co., 906 Date St.
  - Atlas Brass Foundry, Inc., 1901 Santa Fe Ave.
  - Axelson Machine Co., Boyle and Randolph Aves.
  - Bayer-Rothgeb Co., Slauson and Santa Fe Ave.
  - Bunce Metal Products, 2652 Long Beach Ave.
  - Cain Gas Radiator Co., W. H., 5215 Moneta Ave.
  - California Brass Manufacturing Co., 1444 N. Main St.
  - Cass Foundry, 2501 E. Twenty-fifth St.
  - Clark-Turner Piston Co., 2251 E. Seventh St.
  - Commercial Iron Works, 2424 Porter St.
  - D. and B. Pump and Supply Co., 301 West Blvd.
  - Earle Hardware Manufacturing Co., 2369 E. Fifty-first St.
  - Federal Brass Foundry Co., 5330 Santa Fe Ave.
  - Ferrell Brass Foundry, 110 E. Seventeenth St.
  - Fulton Engine Works, N. Main and Alhambra Rd.
  - Graham Iron Works, 2724 Sante Fe Ave.
  - Griffin Wheel Co., 5421 Santa Fe Ave., Vernon.
  - Hartman, Fred C., 632 Mateo St.
  - Hercules Foundries, Inc., Boyle and Slauson Ave., Huntington Park.
  - Hess and Sacket, Inc., 601 W. Belgrave St., Huntington Park.
  - Independent Iron Works, 2416 Lenard St.
  - Johnson Foundry and Machine Works, 1609 N. Main St.
  - Jones Co., James, 201 Leroy St.
  - Kain Fixture and Brass Works, 113 W. Ann St.
  - Kay-Brunner Steel Casting Co., 2720 Frederick St.
  - Keystone Iron and Steel Works, 3601 Santa Fe Ave.
  - Kingman Manufacturing Co., 2201 S. Main St.
  - Layne and Bowler Corp., 900 Santa Fe Ave.
  - Lily Foundry Co., 2268 E. Fifteenth St.
  - Llewellyn Iron Works, N. Main and Redondo Sts.
  - Los Angeles Brass Foundry, 1539 E. Sixteenth St.
  - Los Angeles Foundry Co., 2444 S. Alameda St.
  - Los Angeles Valve and Fittings Co., 2741 Compton Ave.
  - Madsen Iron Works, 5529 Bicket St., Huntington Park.
  - Magnus Co., Inc., 860 N. Main St.
  - Martin Iron Works, 1222 E. Twenty-eighth St.
  - Master Foundry, 1008 Santee St.
  - Mechanical Pattern Works, Inc., Tenth and Stanford Sts.
  - Metal Supply Co., 2323 E. Fifty-second St.
  - Meyberg Co., 631 S. Grand St.
  - Miller Engineering and Foundry Works, 2652 Long Beach Ave.
  - National Brass Works, Inc., 2140 E. Twenty-fifth St.
  - Pacific Brass and Hardware Co., 1646 N. Spring St.
  - Pacific Copper and Brass Works, 1915 E. Seventh St.
  - Pacific Faucet Manufacturing Co., 940 E. Sixtieth St.

Pacific Gas Radiator Co., Harbor Truck Blvd.
Phillips Bronze Bushing Works, 1460 E. Washington St.
Pioneer Brass Works, 1531 E. Thirty-second St.
Podas Foundry Co., 2001 E. Slauson Ave.
Price-Corcoran-Pfister Co., 2923 Humboldt St.
Public Service Brass Corp., 721 E. Slauson Ave., Huntington Park.
Quality Foundry and Manufacturing Co., 2411 Modoc St.
Reliable Iron Foundry, 207 Mesnager St
Republic Brass and Manufacturing Co., 2115 E. Twenty-seventh St.
Rich Steel Products Co., 3855 Santa Fe Ave.
Snow Manufacturing Co., 2437 E. Twenty-fourth St.
Super-Refined Metals Co., 315 West Blvd.
Union Brass Works, 723 N. Main St.
United Casting Co., Wilson and Violet Sts.
Vernon Foundry, 2601 Twenty-sixth St.
Warman Steel Casting Co., Box 639, Station C.
Washington Iron Works, 1141 Mateo St.
Western Machinery Co., 900 N. Main St.
Western Malleable Castings Co., Boyle and Slauson Aves.

Marysville:
Empire Foundry and Machine Works, 424 F St.

Nevada City:
Miner's Foundry and Supply Co.

Newark:
Graham Manufacturing Co.

Niles:
Victory Manufacturing Co.

Oakland:
American Manganese Steel Co.
Best Steel Casting Co., 105th Ave., Station G.
Block Brass Foundry Co., Inc., 760 Twenty-third Ave.
California Foundries, Inc., 950 Nineteenth St.
Dalton and Sons Co., Henry, Cedar, Ninth and Tenth Sts.
DeRome's Bronze, Brass and Bell Foundry, E., 1978 Fifty-ninth St.
Du Mont's Foundry, 2319 Union St.
Economy Mills, 752 High St.
Empire Foundry Co., Inc., 429 Third St.
Hammer-Bray Co., Foot of Madison St.
Key System Transit Co., Twenty-second and Grove Sts.
Marchant's Foundry, Fourth and Powell Sts., Emeryville.
Oakland Brass Foundry, 928 Twenty-third Ave.
Pacific Diesel Engine Co., 2896 Glascock St.
Pacific Malleable Castings Co., Foot of Eighty-fifth St.
Phoenix Iron Works Co., 703 Second St.
Standard Brass Casting Co., 600 Third St.
Standard Gas Engine Co., Denison and King Sts.
United Iron Works, Second and Jefferson Sts.
Western Stove and Range Co. (Elmhurst).

Ontario:
Edison Electric Appliance Co., Inc.

Oxnard:
Brenneis Manufacturing Co.

Pasadena:
Hangliter Manufacturing Co., 983 S. Raymond Ave.
Hopping Bros. Foundry, 367 S. Broadway.
Reliance Manufacturing Co., 1020 S. Broadway.

Pittsburg:
Columbia Steel Corp.

Placerville:
Morey, F. H.

Pomona:
Pomona Manufacturing Company.

Porterville:
Porterville Foundry, Box 581.

- Red Bluff:
  - Hammer, H. H.
- Redding:
  - Johnson Iron Works, I. J.
  - Redding Iron Works.
- Richmond:
  - Pacific Sanitary Manufacturing Co., 67 New Montgomery St.
  - Pullman Co., Pullman and South Sts.
  - Santa Fe Foundry Co., D and Clinton Sts.
- Riverside:
  - Parker Machine Works.
  - Riverside Foundry, 176 N. Main St.
- Sacramento:
  - Berry, R., 1817 Twenty-ninth St.
  - Brainard Bros.
  - Southern Pacific Co.
- San Bernardino:
  - Ellis Iron Works, 135 Arrowhead Ave.
  - Hanford Iron Works, 101 S. Arrowhead Ave.
  - Parker Iron Works, Inc., 943 Third St.
  - Santa Fe R. R. Shop Brass Foundry.
- San Diego:
  - Barth, W. G., 1101 W. Nutmeg St.
  - California Iron Works.
  - Higgins Manufacturing Co., J. C., 2228 Kettner Blvd.
  - San Diego Brass Co., 1511 J St.
  - San Diego Machine Co., 739 Fourth St.
  - Standard Iron Works.
- San Francisco:
  - Ajax Foundry Co., 58 Clementina St.
  - American Brake Shoe and Foundry Company of California, 303 New Call Bldg.
  - American Brass and Bronze Works, 124 Juniper St.
  - Bell Casting Co., 1504 Vallejo St.
  - Bethlehem Shipbuilding Corp., Ltd., Twentieth and Illinois Sts.
  - Brown Co., J. H., 755 Brannan St.
  - Bunting Iron Works, 1216 First National Bank Bldg.
  - Columbia Steel Corp., Balfour Bldg.
  - David Co., P., Sharon Bldg.
  - Dyer, F. G., 766 Folsom St.
  - Enterprise Foundry Co., 2902 Nineteenth St.
  - Eureka Foundry, 625 Brannan St.
  - Excelsior Brass Works, 1168 Bryant St.
  - Federal Ornamental Iron and Bronze Co., Sixteenth and San Bruno Sts.
  - Garratt and Co., W. T., 277 Fremont St.
  - Golden Gate Brass Manufacturing Co., 251 Second St.
  - Golden State and Miners Iron Works, 249 First St.
  - Greenberg's Sons, M., 765 Folsom St.
  - Hendy Iron Works, Joshua, 75 Fremont St.
  - Jewell Steel and Malleable Co. of Cal., Potrero and Twenty-fifth Sts.
  - Judson Manufacturing Co., 819 Folsom St.
  - Kingwell Bros. Brass Foundry, 444 Natoma St.
  - Krenz Copper and Brass Works, Inc., Oscar, 612 Bryant St.
  - Liberty Brass and Bronze Foundry, Sherman and Cleveland Sts.
  - Market Street Railway Co., San Jose and Geneva Aves.
  - McCormack Bros. Iron Works, Main and Folsom Sts.
  - McKay Foundry Co., Seventeenth and Missouri Sts.
  - Mission Foundry and Stove Works, 2256 Harrison St.
  - Moore-Noble Foundry Co., Seventeenth and Mississippi Sts.
  - Pacific Brass and Bronze Foundry, 528 Folsom St.
  - Pacific Diesel Engine Co., 433 California St.
  - Pacific Foundry Co., Harrison and Eighteenth Sts.
  - Pacific Metal Works, Inc., 153 First St.
  - Pacific Sanitary Manufacturing Co., 67 Montgomery St.
  - Polytechnic High School, Frederick and First Sts.

  - Rincon Foundry Co., 349 Seventh St.
  - San Francisco Brass Foundry, 48 Clementina St.
  - San Francisco Stove Works, 260 Townsend St.
  - Star Aluminum Foundry, 3619 Eighteenth St.
  - Steiger and Kerr Stove and Foundry Co., Folsom and Eighteenth Sts.
  - Vulcan Iron Works, 1849 Kearney St.
  - Western Brass Manufacturing Co., 217 Tehama St.
  - Western Foundry, 912 Folsom St.
- San Jose:
  - Anderson Barngrover Manufacturing Co.
  - Axford and DeShields Brass Foundry, 61 S. Fourth St.
  - Bean Spray Pump Co., 217 W. Julian St.
- San Luis Obispo:
  - Smith Foundry, F. L., 254 Higuera St.
- Santa Ana:
  - Kinslow Foundry, H. H., 902 E. Third St.
  - P. V. and R. Products Co., 1316 Santiago St.
  - Santa Ana Iron Works, 924 E. First St.
- Santa Cruz:
  - Enterprise Machine Works, Water and River Sts.
- Santa Rosa:
  - Pioneer Machine Works and Iron and Brass Foundry.
- Sonora:
  - Curnow, R. C.
- Stanford University:
  - Leland Stanford University.
- Stockton:
  - Augustine Brass Foundry.
  - Engineering and Foundry Co., 800 N. East St.
  - Holt Manufacturing Co.
  - Monarch Foundry Co., Inc., Sacramento and Oak Sts.
  - Stockton Iron Works, Lindsay and Harrison Sts.
- Sunnyvale:
  - Hendy Iron Works, Joshua.
- Sutter Creek:
  - Knight Company.
- Taft (Kern County):
  - Midway Iron and Brass Foundry.
- Torrance:
  - Columbia Steel Corp.
  - Union Tool Co.
- Tuolumne:
  - Tuolumne Foundry and Machine Works.
- Upland:
  - Upland Manufacturing Co.
- Vallejo:
  - U. S. Navy Yard Foundry (Mare Island).
- Ventura:
  - Ventura Manufacturing and Implement Co.
- Vernon:
  - Whiting-Mead Co., 2035 E. Vernon St.
- Visalia:
  - Visalia Foundry, Machine Shops and Garage, Inc., 811 E. Main St.
- Wilmington:
  - Wilmington Brass Foundry.

ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Personnel.

There have been no changes or additions in the personnel of the Bureau, to be noted, during the past quarter.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Bulletin No. 95. "Geology and Ore Deposits of the Randsburg Quadrangle," by Carlton D. Hulin. Cloth bound; 148 pp., profusely illustrated, also accompanied by a geological map in five colors and by five maps of mining claims and underground workings. Price $2.00 postpaid.

Mining in California (quarterly). July, 1925, being Chapter 3 of State Mineralogist's Report XXI. Price 25 cents.

Summary of Operations, California Oil Fields: Vol. 10, Nos. 10, 11, and 12, April, May, and June, 1925, respectively.

Commercial Mineral Notes: Nos. 29, 30, 31, August-October (inc.). These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale,' issued in the form of a mimeographed sheet, monthly. It is free of charge to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains, in addition to its correspondence file and the library, a mine report file which includes reports on some 7500 mines and mineral properties in California. Also, there is available to the public a file of the permits granted to mining and oil corporations by the State Commissioner of Corporations.

During the period covered by this quarterly report, there were 1667 letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

Walter W. Bradley, Deputy State Mineralogist.

STATISTICS.

Data on the 1924 production of some of California's minerals were given in both the April and July issues of Mining in California, and figures on additional substances are presented herein, together with tabulations showing the completed totals for all substances for that year, grouped both by substances and by counties. The complete, detailed, annual report on the mineral production of California for 1924 is now in press, as Bulletin No. 96 of the State Mining Bureau.

Summary for 1924.

The total value of the mineral output of California for the year 1924 was $374,620,789 being an increase of $30,596,111 over the 1923 total of $344,024,678. There were sixty different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the fifty-eight counties of the state contributed to the list.

The salient features of 1924 compared with the preceding year were: The increased value of the petroleum yield, although there was a material decrease in quantity; decrease in cement value owing to lower prices, although increased amounts were manufactured; increases in copper, quicksilver, tungsten, granite, marble, miscellaneous stone, limestone, mineral water, potash, and salt; and decreases in natural gas, gold, silver, platinum, brick, magnesite, pottery clay, gypsum, pyrites, and borates. The net result was an increase in the grand total of all groups of nearly thirty-one million dollars, as stated above. Petroleum accounted for an increase of $31,921,565 in total value in spite of a decrease of approximately 34,000,000 barrels in quantity.

Of the metals: Copper increased from 28,346,860 pounds worth $4,166,989 to 52,089,349 pounds worth $6,823,704; quicksilver from 5458 flasks and $332,851 to 7948 flasks and $543,080; and tungsten from 34 tons and $19,126 to 781 tons and $446,009. Gold decreased slightly from $13,379,013 to $13,150,175, in spite of which, as for several years past, California continued to account for approximately 30% of the gold output of the United States. Silver decreased in value from $2,918,743 to $2,381,952, owing to a lower average price.

Of the structural group: Cement advanced in quantity from 10,825,405 barrels to 11,655,131 barrels, but due to foreign importations duty free, the price dropped, resulting in a decrease of total value from $25,999,203 to $23,225,850; granite increased from $760,081 to $1,211,046 in value, due to certain large building contracts notably the Los Angeles County Building; brick and hollow building blocks or tile decreased in total value from $9,738,082 to $9,137,908 owing mainly to a decrease in common brick. Lime and magnesite also registered decreases.

Of the 'industrial' group, as is usually the case, there were a number of fluctuations, the more important increases in value being shown by mineral water and limestone, and decreases in value by diatomaceous earth, pottery clay, gypsum, pyrites, and talc. Of the salines, borates and soda showed decreases, while common salt, potash and magnesium salts advanced in quantity and value.

The above-noted total value of California's mineral industries for 1924 exceeds by more than six million dollars the estimate of the State Department of Agriculture for the farm values of California's agricultural production in 1924 which was placed at $368,427,000.[1]

The economic importance of the mineral industries throughout the United States as a whole is evidenced by a statement[2] recently issued by the U. S. Department of Commerce concerning the freight handled by the railroads of the country, the products of mines representing 51.33 per cent of the whole. The various industries are represented as follows:

Industry		*Freight, per cent*
Agricultural products		10.63
Animals and products		2.23
Forest products		9.64
Manufacturers and miscellaneous		26.17
Mines—		
Anthracite coal	5.68	
Bituminous coal	28.45	
Iron ore	4.23	
Clay, sand, gravel, stone	8.67	
All other mineral products	4.30	
		51.33
Total		100.00

---

[1] Kaufman, E. E., Agricultural statistician, Cal. Co-op. Crop Reporting Section, State Dept. of Agr.; in Sacramento Bee, Jan. 10, 1925.

[2] Eng. & Min. Jour.-Press, Aug. 22, 1925, p. 304.

By Substances.

The distribution of the 1924 output of California by substances is shown in the following tabulation:

Substance	Amount	Value
Asbestos	70 tons	$4,750
Bituminous rock	6,040 tons	14,922
Borates	[1]152,070 tons	1,599,149
Brick and tile		9,137,908
Cement	11,655,131 bbls.	23,225,850
Chromite	350 tons	6,700
Clay (pottery)	417,928 tons	651,857
Coal	1,425 tons	8,800
Copper	52,089,349 lbs.	6,823,704
Dolomite	28,843 tons	71,271
Feldspar	9,055 tons	68,112
Fuller's earth	5,290 tons	67,295
Gems		4,800
Gold		13,150,175
Granite		1,211,046
Gypsum	25,569 tons	53,210
Lead	4,984,387 lbs.	398,751
Lime	62,029 tons	703,355
Limestone	219,476 tons	582,660
Lithia	109 tons	2,269
Magnesite	67,236 tons	900,183
Magnesium salts	4,823 tons	145,883
Manganese ore	1,115 tons	25,785
Marble (including Onyx and Travertine)	61,579 cu. ft.	140,253
Mineral paint	532 tons	5,234
Mineral water	8,159,211 gals.	818,726
Natural gas	209,921,596 M. cu. ft.	15,153,140
Onyx and travertine (combined with Marble)		
Petroleum	228,933,471 bbls.	274,652,874
Platinum	273 fine oz.	36,452
Potash	33,107 tons	747,407
Pumice and volcanic ash	4,919 tons	33,404
Pyrites	124,214 tons	517,835
Quicksilver	7,948 flasks	543,080
Salt	318,800 tons	1,159,137
Sandstone	6,700 cu. ft.	3,600
Silica (sand and quartz)	6,808 tons	35,006
Silver	3,555,153 fine oz.	2,381,952
Soapstone and talc	16,179 tons	242,770
Soda	32,536 tons	711,796
Stone, miscellaneous[2]		15,966,380
Tungsten concentrates	781 tons	446,009
Zinc	3,060,000 lbs.	198,900
Unapportioned[3]		1,968,399
Total value		$374,620,789

[1] Recalculated to 40% 'anhydrous boric acid' equivalent.

[2] Includes macadam, ballast, rubble, riprap, paving blocks, sand, gravel and grinding-mill pebbles.

[3] Unapportioned—Includes aluminum sulphate, glauber salt, potash alum, arsenic, calcium chloride, diatomaceous earth, iron ore, mica schist, shale oil, sillimanite-andalusite, sulphur, and radio galena crystals.

By Counties.

Distribution by counties is given in the following tabulation:

Alameda	$2,634,645	Placer	492,180
Alpine	2,552	Plumas	3,876,105
Amador	2,938,865	Riverside	5,508,244
Butte	641,750	Sacramento	2,196,210
Calaveras	1,572,419	San Benito	2,144,603
Colusa	77,267	San Bernardino	12,642,431
Contra Costa	2,348,090	San Diego	1,013,119
Del Norte	722,265	San Francisco	150,258
El Dorado	395,572	San Joaquin	602,500
Fresno	12,547,798	San Luis Obispo	317,779
Glenn	41,550	San Mateo	302,171
Humboldt	485,478	Santa Barbara	5,159,740
Imperial	139,908	Santa Clara	1,150,401
Inyo	2,110,075	Santa Cruz	4,339,233
Kern	74,161,451	Shasta	4,754,664
Kings	725	Sierra	812,476
Lake	96,396	Siskiyou	140,787
Lassen	37,908	Solano	3,089,475
Los Angeles	168,420,709	Sonoma	172,051
Madera	955,469	Stanislaus	345,138
Marin	527,231	Sutter	97
Mariposa	234,707	Tehama	34,454
Mendocino	60,768	Trinity	509,344
Merced	87,603	Tulare	498,674
Modoc	1,300	Tuolumne	629,156
Mono	126,691	Ventura	6,089,394
Monterey	286,490	Yolo	15,800
Napa	359,265	Yuba	2,189,881
Nevada	2,945,267		
Orange	40,481,210	Total	$374,620,789

Total Mineral Production of California, by Years.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau began. At the side of these figures the writer has placed the values of the most important metal and nonmetal items—gold and petroleum.

In the same period copper made an important growth beginning with 1897 following the entry of the Shasta County mines, and more recently Plumas County. Cement increased rapidly from 1902, while crushed rock, sand and gravel as a group parallels the cement increase. Quicksilver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. War-time increases, 1915–1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc. Most of these, except silver, have since declined; with structural materials and copper increasing in 1920–1924; also lead and magnesite in 1923.

Total Mineral Production of California by Years, Since 1887.

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,614	$1,357,144
1888	19,469,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	18,039,666	12,309,793	384,200
1891	18,872,413	12,728,869	401,264
1892	18,300,168	12,571,900	561,333
1893	18,811,261	12,422,811	608,092
1894	20,203,294	13,923,281	1,064,521
1895	22,844,663	15,334,317	1,000,235
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	15,906,478	2,376,420
1899	29,313,460	15,336,031	2,660,793
1900	32,622,945	15,863,355	4,152,928
1901	34,355,981	16,989,044	2,961,102
1902	35,069,105	16,910,320	4,692,189
1903	37,759,040	16,471,264	7,313,271
1904	43,778,348	19,109,600	8,317,809
1905	43,069,227	19,197,043	9,007,820
1906	46,776,085	18,732,452	9,238,020
1907	55,697,949	16,727,928	16,783,943
1908	66,363,198	18,761,559	26,566,181
1909	82,972,209	20,237,870	32,398,187
1910	88,419,079	19,715,440	37,689,542
1911	87,497,879	19,738,908	40,552,088
1912	89,972,385	19,713,478	41,868,344
1913	98,644,639	20,406,958	48,578,014
1914	93,314,773	20,653,496	47,487,109
1915	96,663,369	22,442,296	43,503,837
1916	127,901,610	21,410,741	57,421,334
1917	161,202,962	20,087,504	86,976,209
1918	199,753,837	16,529,162	127,459,221
1919	195,830,002	16,695,955	142,610,563
1920	242,099,667	14,311,043	178,394,937
1921	268,157,472	15,704,822	203,138,225
1922	245,183,826	14,670,346	173,381,265
1923	344,024,678	13,379,013	242,731,309
1924	374,620,789	13,150,175	274,652,874
Totals	$3,470,395,816	$628,747,742	$1,883,138,099

BRICK AND TILE.

Bricks of many varieties and in important quantities are annually produced in California, as might be expected in a state with such diversified and widespread mineral resources. The varieties include common, fire, pressed, glazed, enamel, fancy, vitrified, sand-lime and others. So far as possible, the figures for the different kinds are segregated in the annual statistical bulletin of the State Mining Bureau. We also include under this heading the various forms of hollow building 'tile' or blocks, the use of which is increasing annually.

The values by counties in 1924 were distributed as follows:

Brick and Tile Values, 1924.

County	Value
Alameda	$763,476
Contra Costa	327,225
Fresno	95,014
Los Angeles	5,484,987
Mendocino	7,125
Placer	186,053
Riverside	493,746
Sacramento	290,213
San Diego	232,113
San Joaquin	462,688
San Luis Obispo	35,987
Santa Clara	217,172
Amador, Humboldt, Imperial, Kern, Marin, Merced, Orange, Santa Barbara, Tehama, Tulare*	542,109
Total value	$9,137,908

*Combined to conceal output of a single operator in each.

CLAY (pottery).

In the statistical reports of the State Mining Bureau, 'pottery clay' refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flower-pots, floor, faience and ornamental tiling, architectural terra cotta, sewer pipe, drain and roofing tile, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form or was immediately used in the manufacture of any of the above finished products by the producer. So far as we have been able to segregate the data furnished us, the 'pottery clay' figures do not include material utilized in making brick and hollow building blocks.

During 1924, a total of 48 producers in 19 counties reported an output of 417,928 short tons of pottery clay, having a total value of $651,857 f.o.b., rail-shipping point, for the crude material, as compared with the 1923 production of 376,863 tons worth $697,841. This was distributed, by counties, as follows:

Pottery Clay in 1924.

County	Tons	Value
Alameda	2,482	$1,124
Amador	64,317	87,444
Los Angeles	84,065	132,855
Monterey	238	436
Placer	97,670	146,508
Riverside	121,193	166,692
Sacramento	1,750	4,470
San Diego	[b] 12,783	36,941
Santa Clara	5.341	5,666
Calaveras, Contra Costa, Humboldt, Kern, Marin, Merced Orange, San Bernardino,[a] Santa Barbara, Tuolumne *	28,089	69,721
	417,928	$651,857

* Combined to conceal output of a single operator in each.

[a] Includes kaolin.

[b] Includes 'Cornwall stone.'

COAL.

Coal production in California in 1924 amounted to a total of 1425 short tons valued at $8,800, being credited to Amador, Mendocino, Riverside, San Benito, Shasta, and Siskiyou counties. With the exception of a small tonnage marketed locally in Amador County, the above output was almost entirely consumed for camp purposes and for power and forge use in development work on deposits. The 1923 figures were 1010 tons and $5,090, credited to Mendocino and Riverside counties.

FELDSPAR.

Feldspar was produced by nine operators in two counties (Riverside and San Diego) during 1924, to the amount of 9055 tons, valued at $68,112, being a slight decrease, both in quantity and value from the 1923 figures of 11,100 tons and $81,800.

The product was used in the ceramic industry, principally in pottery, porcelain, enamel wares, also enamel brick and tile, being a constituent of both the body and the glaze, but more especially of the latter.

The most important developments in recent years in the feldspar resources of California have taken place in San Diego and Riverside counties where large deposits of massive, high-grade spar are being opened up.

GRANITE.

The value of the granite output of California for 1924 was the highest recorded for any year since 1891, due mainly to the contract for the construction of the new Los Angeles County Building. Stone for 'monumental' and decorative purposes showed an increase in quantity but a decrease in total value. The net result was an increase in total value of the several groups from $760,081 to $1,211,046, segregated as follows:

Class	Amount	Value
Building stone	459,472 cu. ft.	$819,972
Monumental stone	131,061 cu. ft.	360,659
Curbing	500 lin. ft.	1,500
Unclassified	14,426 cu. ft.	28,915
Total value	-------------	$1,211,046

The most important district is Madera County, followed in turn by San Diego, Fresno, and Tulare, with smaller amounts from Placer, Nevada, Plumas, Riverside and Sacramento. Some tuff from Inyo and Los Angeles counties, used for building stone, is included in the above.

LIME.

Lime to the amount of 62,029 tons, valued at $703,355 was produced by 11 plants in eight counties during 1924, as compared with 70,894 tons, valued at $788,834 in 1923. There were two plants each in Kern, San Bernardino, and Santa Cruz counties, and one each in El Dorado, Inyo, San Diego, Siskiyou, and Tuolumne.

So far as we have been able to segregate the data, these figures include mainly only such lime as is used in building operations; though they do include a small proportion of calcined lime employed in agriculture and the chemical industries, the figures for which were not separable. A portion is hydrated lime. Limestone utilized in sugar making, for smelter flux, as a fertilizer, and other industrial uses, is classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

LIMESTONE.

'Industrial' limestone was produced in 12 counties during 1924, to the amount of 219,476 tons, valued at $582,660, being an increase both in quantity and value over the 1923 output of 143,266 tons worth $348,464.

The amount here given does not include the limestone used in the manufacture of cement, nor for macadam and concrete, nor of lime for building purposes; but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel,' paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken dust, chicken grit, carbon dioxide gas, 'paving compound', facing dust for concrete pipe, also for rubber and magnesite mix. Of the total product in 1924, approximately 24,000 tons valued at $85,000 was used for agricultural purposes.

MANGANESE.

Manganese ore shipments in California in 1924 amounted to a total of 1115 tons of all grades, valued at $25,785, being an increase both in quantity and value over the 1923 yield which totaled 690 tons and $10,620 value. These ores showed analyses of from 46% to 59% Mn, and were utilized almost entirely by Pacific Coast steel plants for ferro-manganese.

Importations of foreign manganese ores in 1924, mainly from Brazil, amounted to a total of 255,157 long tons valued at $6,084,686 compared with 206,048 long tons and $3,874,510 in 1923. The Tariff Act of 1922 provides for an import duty of 1¢ per pound on the metallic manganese contained, for "manganese ore or concentrates containing in excess of 30 per centum of metallic manganese." The bulk of such ore is consumed in the large steel-producing centers of the eastern United States.

MINERAL WATER.

Commercial production of mineral water in California for 1924 amounted to a total of 8,159,211 gallons valued at $818,726, being an increase both in quantity and value over the high-record figures of 1923. The 1924 output was distributed by counties as follows:

Mineral Water Production, by Counties, 1924.

County	Gallons	Value
Butte	6,000	$4,500
Calaveras	1,400	139
Lake	66,420	59,423
Los Angeles	1,889,285	88,942
Napa	73,608	53,391
Riverside	78,560	23,021
San Diego	107,097	8,642
Siskiyou	300,500	6,100
Sonoma	31,003	8,002
Colusa, Contra Costa, Humboldt, Marin, Monterey, Placer, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Santa Clara, Solano*	5,605,338	566,566
Totals	8,159,211	$818,726

*Combined to conceal output of a single operator in each.

The production above tabulated was in part bottled with artificial carbonation, in part natural, and a large part was used in the preparation of soft drinks with flavors.

Although some of the operators complain that prohibition has all but killed off the mineral water business, the reports of the actual production of mineral water bottled and sold indicate an encouraging growth and a material increase annually both in total quantity and value.

NATURAL GAS.

There is rather a wide variation in prices quoted for natural gas because a considerable part is used directly in the fields for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have placed a valuation on their returns to the State Mining Bureau on the gas that was thus used in 1924 gave from 3¢-25¢ per 1000 cubic feet, at the well. From the totals shown in the tabulation below, the average value for all fields in 1924 works out at approximately 7.2¢. Approximately 7000 cubic feet of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines about 4000 cubic feet per 24 hours are consumed by a 25-h.p engine, and 63,700 cubic feet per day for heating a 70-h.p. steam boiler, which figures have been utilized in compiling the tabulation below.

Natural Gas 'Consumed' or Utilized for Fuel, 1924.

County	M Cu. Ft.	Value
Fresno	1,430,708	$102,286
Kern	47,881,308	2,522,551
Kings	1,480	725
Los Angeles	122,838,521	9,191,395
Orange	29,812,139	2,397,813
Santa Barbara	1,643,355	158,836
Tulare	1,080	540
Ventura	5,995,760	633,352
Butte, Humboldt, Lake, Mendocino, Sacramento, San Joaquin, San Luis Obispo, Sutter, Yuba*	317,245	145,642
Totals	209,921,596	$15,153,140

*Combined to conceal output of a single operator in each

The above totals for 1924 compare with 240,405,397 M cubic feet valued at $15,661,433 in 1923, which year was nearly 2½ times the quantity and more than double the value of 1922.

The 1923 total of quantity was approximately one-half of the previously recorded total for California for the years 1888–1922, inclusive; and the 1923 total of value equaled 41% of the total value for the same period. This was due to remarkable increases in the Los Angeles and Orange County fields. In 1924, the quantities of natural gas utilized in those two counties decreased; Kern and Ventura counties showed increases.

The compiled figures for 1924 received from two of the larger agencies handling natural gas and natural-gas gasoline, total somewhat higher than the aggregate of the data received direct by the State Mining Bureau from the separate plants and operators. Assuming that our list of operators may have lacked some names, from whom we thereby lacked returns, we have taken an average of these several sets of figures as the basis for the present report. Compared with 1923, there was a decrease in Los Angeles County in the amount of gas consumed, owing to the decline in oil production in the older of the new fields. There was an increase in gasoline recovered from natural gas because in the newest two fields (Rosecrans and Dominguez) there was a large flow of gas but no pipe-line facilities for conveying it to the consuming centers. In this case, the gasoline was 'squeezed' out of a portion and the dry gas blown into the air unconsumed.

PUMICE.

The production of pumice and volcanic ash for the year 1924 amounted to 4919 tons valued at $33,404 and came from properties in Imperial, Inyo, and Kern counties. This is an increase both in tonnage and value over the 1922 shipments which totaled 2936 tons and $16,309. The material from Imperial County is of the vesicular, block variety and was sold for abrasive purposes; that from Inyo and Kern is the volcanic ash, or tuff, variety and was employed in making soap and cleanser compounds.

SALT.

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey, and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds (including some rock salt) in the desert regions, mainly in Kern and San Bernardino counties. A small amount of valuable medicinal salts is obtained by evaporation of the water of Mono Lake, Mono County.

Distribution of the 1924 production by counties was as follows:

County	Tons	Value
Alameda	189,217	$635,653
Kern	10,506	44,115
San Bernardino	29,699	99,791
San Mateo	52,258	205,176
Los Angeles, Modoc, Mono,[a] Monterey, San Diego*	35,120	174,402
Totals	318,800	$1,159,137

[a] Medicinal salts.
*Combined to conceal output of a single operator in each.

The above returns show an increase both in tonnage and value over the 1923 figures, establishing a new high record for this industry in California. There were nine plants operating in Alameda County, and a total of twelve plants in the other counties tabulated, being an increase of three over the total number operated in 1923.

SANDSTONE.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of lighter-colored building stones, has curtailed production during recent years almost to the vanishing point. In 1924 two counties—Monterey and Ventura—turned out 6700 cubic feet valued at $3,600, compared with 7000 cubic feet and $13,000 in 1923. The main feature of the loss since 1914 is the closing of the well-known Colusa quarries, on account of the competition of lighter-colored materials. The material reported from Monterey County in 1924 is in reality an indurated shale of the Monterey series, of a cream-color and utilized as a building stone.

SILICA.

The production of silica (sand and lump quartz) in California in 1924 amounted to 6808 tons valued at $35,006, from eight properties in four counties. We combine these materials because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

A portion of the tonnage of vein quartz in California is utilized as a foundry flux and for steel-casting moulds; and part of the 1924 output was used for roofing and stucco-dash granules. A portion of the silica sold (both sand and quartz) is also used in glazes for porcelain, pottery and tile, and in the body of the ware to diminish shrinkage; and some of the sand for the preparation of sodium silicate ('water-glass').

STONE (miscellaneous).

'Miscellaneous stone' is the designation used in the reports of the State Mining Bureau as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills.

For the year 1924, crushed rock registered gains both in tonnage and value over the preceding year; but sand and gravel showed a slight decrease. The result was a net gain for the group, the 1924 total value being $15,966,380 as compared with $15,395,652 in 1923. Continuance of general building work and highway paving are in part responsible as well as hydro-electric power-plant installation and harbor protection (breakwater and jetty construction).

As for some years past, Los Angeles County led all others by a wide margin with an output valued at $5,923,329 (compared with $5,408,803 in 1923); followed by Alameda, second, with $1,158,886; Del Norte, third, $721,720; Contra Costa, fourth, $646,369; Sacramento, fifth, $639,811; Shasta, sixth, $587,637; Riverside, seventh, $561,861; Orange, eighth, $505,932; followed in turn by Humboldt, Fresno, San Diego, Marin, San Bernardino, San Benito, Napa, and Santa Clara, in the order named, each with a total between a half and a quarter-million dollars.

Paving Blocks.

The paving block industry has decreased materially of recent years, almost to the vanishing point, because of the increased construction of smoother pavements demanded by motor-vehicle traffic. Shipments in 1924 amounted to only 11 M, valued at $935.

Grinding-Mill Pebbles.

Production of pebbles for tube and grinding mills began commercially in California in 1915. Shipments in 1924 totaled 434 tons, valued at $2,969, a decrease from the 2650 tons and $14,936 of 1923.

Sand and Gravel.

A considerable part of the gravel excavated is passed through grading and washing plants, and the material over 2 inches in size is crushed. Much of it is utilized in concrete mixtures. Most of the gravel used for road surfacing and repairs as well as that for railroad ballast is creek-run or pit-run material which is spread upon the roads without undergoing any grading or washing.

The distribution of the 1924 output of sand and gravel, by counties, is shown in the following table:

County	Tons	Value
Alameda	[a]1,262,095	$809,818
Butte	80,000	45,500
Calaveras	86,124	56,000
Colusa	100,222	75,167
Contra Costa	[a]87,763	48,004
El Dorado	1,279	2,538
Fresno	376,779	262,722
Glenn	189,188	41,550
Humboldt	233,626	190,109
Imperial	59,385	14,958
Kern	15,345	4,044
Lake	33,337	11,113
Lassen	240	100
Los Angeles	3,479,620	1,720,251
Mariposa	43,870	36,000
Merced	15,090	8,462
Mono	500	300
Monterey	[b]245,896	239,097
Napa	187,376	151,876
Nevada	30,262	22,200
Orange	516,900	405,932
Placer	17,433	10,753
Riverside	[a]14,300	14,500
Sacramento	[a]350,021	217,159
San Benito	52,688	26,111
San Bernardino	759,825	241,376
San Diego	[a]323,931	306,953
San Francisco	10,000	5,000
San Joaquin	155,547	79,504
San Mateo	47,671	28,589
Santa Barbara	66,004	45,777
Santa Clara	217,592	155,053
Santa Cruz	15,033	13,294
Shasta	177,265	197,078
Sierra	14,292	7,750
Siskiyou	21,600	16,000
Sonoma	164,932	69,556
Stanislaus	119,152	108,050
Tehama	16,435	15,694
Trinity	1,360	1,240
Tulare	5,000	8,000
Ventura	[a]177,454	113,763
Yuba	259,997	181,113
Amador, Madera, Marin, Mendocino, Modoc, San Luis Obispo, Solano, Yolo*	105,376	63,953
Totals	10,137,805	$6,072,007

*Combined to conceal output of a single operator in each.

[a] Includes molding sand.

[b] Includes molding, blast, filter and roofing sand.

Included in the above is a total of 32,968 tons of molding sand, valued at $68,105 f. o. b. pit, from two operators in San Diego County, and one each in Alameda, Contra Costa, Monterey, Riverside, Sacramento, and Ventura. This item is each year assuming a more important position in the commercial mineral list of California. The 1923 molding sand figures totaled 33,194 tons and $66,634.

Crushed Rock.

To list the kinds and varieties of rocks utilized commercially under this heading would be to run almost the entire gamut of the classification scale. Much depends on the kind available in a given district. In many localities, river-wash boulders form an important source of such material. In such cases, combined crushing and washing plants obtain varying amounts of sand and gravel along with the crushed sizes.

The values given are based upon the selling prices, f. o. b. cars, barges, or trucks at the quarry.

Crushed Rock Production, by Counties, for 1924.

County	Macadam and Ballast		Rubble and Riprap		Concrete		Unclassified		Totals	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	31,337	$27,580	150	$720	219,701	$306,416	[a]24,634	$14,352	275,822	$349,068
Alpine	3,066	2,530							3,066	2,530
Butte	20,000	15,000					[c]95,500	77,500	115,500	92,500
Calaveras							[c]7,500	27,250	7,500	27,250
Contra Costa	32,705	31,378	2,974	3,347	50,034	56,289	622,474	507,351	708,187	598,365
Fresno							248,756	188,818	248,756	188,818
Humboldt	76,286	166,340	[d]40,000	120,000					116,286	286,340
Imperial	1,500	1,500	62,637	11,750	40,912	41,824	8,000	8,000	113,049	63,074
Lake	5,860	11,720							5,860	11,720
Lassen	42,330	35,514							42,330	35,514
Los Angeles	1,592,340	1,013,943	244,796	391,674	2,775,654	1,970,228	[f,g]1,124,310	827,233	5,737,100	4,203,078
Marin			*		*		[c]8,250	6,500	8,250	6,500
Mariposa							[c]2,270	12,000	2,270	12,000
Mendocino	28,266	46,680							28,266	46,680
Mono	14,790	18,744							14,790	18,744
Napa	46,554	41,549			43,059	44,098	21,333	24,000	110,946	109,647
Placer	5,000	3,000	710	820			450	1,000	6,160	4,820
Riverside	*		*		*		[h]1,350	12,650	1,350	12,650
Sacramento	80,621	51,201	6,143	3,378	50,452	52,542	428,486	315,531	565,702	422,652
San Benito	298,063	207,258			*				298,063	207,258
San Diego	1,000	500	3,744	4,712	41,673	45,460	41,333	18,500	87,750	69,172
San Francisco	1,200	600	47,473	60,529	1,400	1,000	57,794	83,129	107,867	145,258
San Mateo	30,345	30,214			13,466	15,150	666	1,125	44,477	46,489
Santa Clara	10,000	7,500			5,000	3,000	124,626	93,470	139,626	103,970
Santa Cruz	6,924	5,322	*		*				6,924	5,322
Shasta	96,417	146,090	2,442	2,748	161,529	241,721			260,388	390,559
Sierra					500	250			500	250
Siskiyou	62,731	51,787							62,731	51,787
Sonoma	25,395	26,042	61	46	3,637	5,365			29,093	31,453
Tehama	10,327	10,260			133	100			10,460	10,360
Trinity							500	1,000	500	1,000
Tulare	39,356	29,729	6,769	1,062	15,000	20,000	[h]20,235	21,620	81,360	72,411
Tuolumne	2,100	1,500					[i,k]2,080	11,000	4,180	12,500
Ventura	26,000	34,000			12,000	18,000	9,072	7,574	47,072	59,574
Amador, Del Norte, Inyo, Merced, Nevada, Riverside, San Luis Obispo, Santa Barbara, Solano*	373,806	443,978							373,806	443,978
Del Norte[d], Madera, Marin, Riverside, San Bernardino, Santa Cruz*			496,171	736,274					496,171	736,274

Marin, Nevada, Orange, Riverside, San Benito, San Bernardino, San Joaquin, Santa Cruz, Stanislaus*					985,455	856,332			985,455	856,332
Amador[b], Inyo[e][f], Kern[g], San Bernardino, Santa Barbara, Solano*							165,711	154,572	165,711	154,572
Totals	2,964,319	$2,461,459	914,070	$1,337,060	4,419,605	$3,677,775	3,015,330	$2,414,175	11,313,324	$9,890,460

*Combined to conceal output of a single operator in each.

[a] Includes red shale, roofing granules.

[b] Includes red sandstone roofing granules.

[c] Includes green stone for roofing and stucco dash.

[d] Includes large stone up to 10-ton blocks for breakwater (jetty) construction.

[e] Includes yellow dolomitic marble for stucco granules.

[f] Includes red roofing granules.

[g] Includes red and green roofing granules.

[h] Includes granite granules for roofing and stucco dash.

[j] Includes quartz granules for roofing.

[k] Includes marble granules for terrazzo.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors, as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

FRANK SANBORN, Mineral Technologist.

During the past three months a few interesting samples of gold and silver ores have been received at the laboratory, proving that these precious metals are still found in new prospects.

From Alpine County there recently was received a sample of rock that would by panning yield a heavy concentrate in small amounts. This concentrate resembled a ruby-like garnet in some respects. The prospector requested an identification of this mineral. This ruby-like mineral proved to be ruby silver, and the sample contained a gold value of nearly ten dollars per ton, although no gold was visible in panning. From the letter accompanying the sample, it would seem that the prospect was never before discovered, and it is possible that this prospect may develop into something of value.

From Calaveras County there was received also a sample of quartz containing considerable pyrite; this sample would show a small amount of free gold in panning, but an assay proved the ore to contain gold values in excess of $300 per ton.

From Inyo and other counties similar samples have been received. The prospectors in each case examined their pan concentrates carefully, and noticing minerals that would concentrate, had them identified.

There are undoubtedly many valuable gold and silver deposits still remaining undiscovered in some of our counties. The prospectors, who are good observers, will eventually find these prospects that will develop into good producing mines.

During the three-month period covered by this report, 1083 samples were received and determined at the laboratory of the State Mining Bureau. The interesting counties of Inyo, Alpine, Mono, and San Bernardino appear to have fewer prospectors seeking veins of the precious metals—gold and silver—however. During recent months there has been a notable increase in the prospecting for valuable aluminum silicates and other nonmetallic minerals and a decided decrease in the search for gold and silver.

LIBRARY.

FOREST L. CAMPBELL, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

- U. S. Geological Survey:
  - Mineral Resources of the United States:
    - Bauxite and Aluminum in 1924.
    - Gold, silver, copper, lead, and zinc in New Mexico and Texas in 1923.
    - Fuller's Earth in 1924.
    - Peat in 1924.
    - Petroleum in 1924.
    - Summary Report of Mineral Resources in 1924.
    - Cadmium in 1923-1924.
    - Quicksilver in 1924.
    - Tin in 1924.
  - Bulletin No. 781-A—Paleozoic Formations Penetrated by Wells in Tishomingo County, Northeastern Mississippi. By M. N. Bramlette.
  - Bulletin No. 766—Spirit Leveling in California, 1876–1923. By C. H. Birdseye.
  - Bulletin 773-E—Geology and Gold Placers of the Chandalar District, Alaska. By J. B. Mertie, Jr.
  - Water Supply Paper No. 545—Hudson Bay and Upper Mississippi River Basins.
  - Water Supply Paper No. 529—Part IX, Colorado River Basin.
  - Water Supply Paper No. 499—The Papago Country, Arizona. By Kirk Bryan.
- U. S. Bureau of Mines:
  - Bulletin No. 235—Mine Timber, Its Selection, Storage, Treatment and Use. By R. R. Horner.
  - Bulletin No. 222—The Metallurgy of Quicksilver. By L. H. Duschak.

Bulletin No. 231—Investigation of Toxic Gases from Mexican and Other High Sulphur Petroleums and Products.

Bulletin No. 237—Tests of a Large Boiler Fired with Powdered Coal.

Bulletin No. 247—Sources of Limestone, Gypsum and Anhydrite for Dusting Coal Mines to Prevent Explosions.

Technical Paper No. 373—The Pyrotannic Acid Method for the Quantitative Determination of Carbon Monoxide in Blood and in Air. By R. R. Sayers.

Reports of Investigation:

Serial No. 2693—Coal-Mine Fatalities in May, 1925. By W. W. Adams.

Serial No. 2694—Present Trend in Flotation Flow-Sheets and Classification of Flotation Feed. By A. W. Fahrenwald.

Serial No. 2695—Additions, Removals and Changes, in Permissible List of Explosives, from January 1, 1925, to June 30, 1925. By J. E. Crawshaw.

Serial No. 2696—Consumption of Explosives in May, 1925. By W. W. Adams.

Serial No. 2697—Methods of Increasing Lump-Coal Production, with Especial Reference to Southern Illinois. By W. E. Tiffany and J. J. McKitterick.

Serial No. 2698—Barium Polysulphide in Sulphidizing Oxide Ores for Flotation. By E. S. Leaver and H. M. Lawrence.

Serial No. 2699—Coal-Mine Fatalities in June, 1925. By W. W. Adams.

Serial No. 2700—Present Status of Differential Flotation. By A. W. Fahrenwald.

Serial No. 2701—Consumption of Explosives, June, 1925. By W. W. Adams.

Serial No. 2702—Coal-Mine Fatalities in July, 1925. By W. W. Adams.

Serial No. 2703—Twelfth Semi-Annual Motor Gasoline Survey. By I. N. Beall, H. M. Thorne and John Devine.

Serial No. 2704—Welfare and Safety in Connection with Mining in Utah. By Dr. A. L. Murray.

Serial No. 2705—Calcium-Sulphate Retarders for Portland Cement. By Ernest E. Berger.

Serial No. 2706—Consumption of Explosives in July, 1925. By W. W. Adams.

Serial No. 2707—Coal-Mine Fatalities in August, 1925. By W. W. Adams.

Serial No. 2708—Miscellaneous Analyses of Foreign Coals.

U. S. Coast and Geodetic Survey. Magnetic Declination in North Carolina in 1925.

U. S. Department of Agriculture. Soil Survey of Tucker County, West Virginia. By S. W. Phillips.

Alabama Geological Survey. Bulletin No. 29—Statistics of the Mineral Production of Alabama for 1923.

California Bureau of Labor Statistics. 21st Biennial Report, 1923–1924.

California Department of Public Works. Report of the Division of Engineering and Irrigation of the State of California to Accompany the Second Biennial Report, Nov. 30, 1924.

Colorado Bureau of Mines. Annual Report for 1924.

Illinois State Geological Survey. Bulletin No. 28—Preliminary Report on Coal Stripping Possibilities in Illinois. By H. E. Culver.

Michigan Geological Survey. Production and Value of Mineral Products in Michigan for 1923 and Prior Years.

Nebraska State Museum:

Bulletin No. 1—A Preliminary Report of the Nebraska State Museum.

Bulletin No. 2—Elephas Scotti—A New Primitive Mammoth from Nebraska.

Bulletin No. 3—Prosthennops Xiphodonticus—A New Fossil Peccary from Nebraska.

Bulletin No. 4—An American Fossil Giraffe.

Bulletin No. 5—Manganese Fulgarites.

Bulletin No. 6—Notes on Nebraska Fulgarites. By E. H. Barbour.

Bulletin No. 7—Sand Fulgarities from Nebraska. By A. E. Anderson.

Tennessee Division of Geology. Bulletin No. 35—Administrative Report of the State Geologist, 1923 to 1924.

Virginia Geological Survey. Bulletin No. 11—The Physiography of the Upper James River Basin in Virginia. By F. J. Wright.

Australia, Commonwealth of:

Report of Petroleum Investigations Made in New South Wales.

The Possibility of Oil Discovery in Queensland.

Canada Department of Mines:

Geological Survey Summary Report, 1924, Part A.

Bituminous Sands of Northern Alberta-Sidney. By C. Ells.

Ontario Department of Mines:

Vol. XXXIII. Part VI. 1924.

Vol. XXXIII. Part VII. 1924.

Bulletin No. 51—Preliminary Report on the Mineral Production of Ontario in 1923.

Bulletin No. 53—Preliminary Report on the Mineral Production of Ontario in 1924.

Press Bulletin—Mineral Production of Ontario, Jan. 1 to June 30, 1925.

32d Annual Report of the Ontario Department of Mines, Part I, 1923, Part IV, 1923.

Scientific and Industrial Research Council of Alberta. Fifth Annual Report.

Finlands, Commission Geologique de:

No. 72—Das Gebiet Der Alkaligesteine von Kulajarvi in Nordfinnland. By Victor Hackman.

No. 73—Uber das Jotnische Gebiet von Satakunta. By A. Laitakari.

Great Britain, Geological Survey of:

Vol. XXX—Copper Ores of the Midlands Wales, the Lake District and the Isle of Man.

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for 1924.

Japan, Tohoku Imperial University, Sendai. Vol. VII, No. 3, Second Series (Geology).

Japan Imperial University. Journal of the Faculty of Science. Vol. I, Part I.

Queensland, Royal Society of: Proceedings of, for 1925, Vol. XXXVI.

Russia Institute of Economic Mineralogy and Petrigraphy, Transactions of:

No. 49—Recent Problems in Working Colored and Precious Stones. By A. Fersman.

No. 61—The Carbon Scrap Process. By G. L. Sakharoff.

No. 66—The Mineral Composition of the Skeletons of Some Invertebrates from Barents and Kara Seas. By J. V. Samol.

No. 73—On the Obtainment of Sodium Chromate. By N. F. Joushvith.

No. 74—The Deposits of the Radium Ore in the Fergana District. By A. E. Fersman.

No. 77—The Natural Iron Dyes. By I. Kourbatoff.

No. 86—The Investigation of Kolchoeg-Alumin.

No. 88—A Sketch of the Localities of Colored Stones in Southeast Transbaikal District. By P. P. Soustzinsky.

No. 90—The Genetic Relations of Deposits of Ore in the Krivoy Rog. By P. Piatnitsky.

No. 92—Deposits of Silica of Organic Origin. By J. V. Samol.

Sweden, The University of. Vol. XVII—The Trilobites of the Leptaena Limestone in Dalarne. By Elsa Warburg.

Uruguay, Institute de Geologia and Perforaciones. Boletin 7—Las Esquestos Bituminosos de Cerro Largo y Los Ensayos Practicados en el Laboratorio del Instituto en 1917. By J. Wanters.

Societies and Educational Institutions.

California, University of:

Vol. 15, No. 11—A Contribution to the Paleontology of the Martinez Eocene of California. By R. N. Nelson.

No. 10—Geology of the Hydrographic Basin of the Upper Santa Ynez River, California. By R. N. Nelson.

Missouri School of Mines and Metallurgy. Vol. 8, No. 1—Reduction of Zinc Oxide by Carbon. By G. A. Zoller.

University of Missouri:

A Treatise on Missouri Clays.

A Study of Reinforced Concrete Dams. By Elmo G. Harris.

American Philosophical Society. Vol. LXIV, No. 2.
  Mining and Metallurgical Society of America:
    Bulletin No. 175—Report of the Subcommitee on Vanadium.
    Bulletin No. 176—Special Report on Supply, Consumption and Stocks of Petroleum (Crude and Refined) in the United States.
    Bulletin No. 177—Progress Report of the Committee on Antimony and the Committee on Foreign and Domestic Mining Policy.
    Bulletin No. 178—Report of the Subcommittee on Tungsten.
    Officers, Members and Committees.
Smithsonian Institution, The—Annual Report, 1923.
  U. S. National Museum, Proceedings of the—Vol. 65.

Topographic Maps.

Alaska, 17 by 24 inches.
Aransas Pass, Texas.
Belmont, New York.
Cub Run, Kentucky.
Herscher, Illinois.
Irasburg, Vermont.
Lanai, Hawaii.
Leitchfield, Kentucky.
Acord Lakes, Utah.
Altenburg, Mo.-Ill.
Attean, Maine.
Buck Hill, Texas.
Cambridge Springs, Pa.
Carlinville, Ill.
Castle Dale, Utah.
Corpus Christi, Texas.
Danville, Va.-N. C.
Delaware, Ohio.
Elgin, Ill.
Sunland, Cal.
Burris Park, Cal.
Lethent, Cal.
Maysville, Mo.
Peterstown, W. Va.-Va.
Pilot Knob, Colo.
Plattsburg Mo.
Quincy, Ill.-Mo.
Raymond, Illinois.
Taylorville, Illinois.
Gower, Mo.
Harrisburg, Ill.
Hiawatha, Utah.
Lobelia, W. Va.
Marlinton, W. Va.
Oso Creek, Texas.
Robstown, Texas.
Sawtelle, Cal.
Scofield, Utah.
Spring Lick, Ky.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Bulletin, Union Oil Co., Los Angeles.
California Journal of Development, San Francisco.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical Engineering and Mining Review, London, England.
Engineering and Mining Journal-Press, New York.
Explosives Engineer, Wilmington, Del.
Financial Insurance News, Los Angeles, California.
Graphite, Jersey City.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mine and Quarry, Chicago.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil and Gas News, Kansas City.
Oil News, Galesburg, Illinois.
Oildom, New York.

Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, San Francisco, Cal.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

31-21 Field geology or topographic work. Eighteen months' experience, geological, mapping, etc. Age 26. Single. References. Salary open.

31-22 Field geology or topographic work. Experience as instrument man. Age 21. Single. References. Salary open.

31-23 Superintendent or manager. Twenty-one years' experience as superintendent and manager at large copper and zinc mines, and general exploration work. Age 43. Married. References. Salary open.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; Sun Finance Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist. 1890. 983 pp., 179 illustrations. 10 maps. William Irelan. Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist. for the two years ending September 15. 1892. 612 pp., 73 illustrations, 4 maps. William Irelan. Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources. Amador. Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources. Colusa. Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte. Humboldt, and Mendocino Counties. 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa. Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties. 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
Fourteenth Report of the State Mineralogist. for the Biennial Period 1913–1914, Fletcher Hamilton. 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras. Tuolumne. Colusa. Glenn. Lake. Marin. Napa. Solano. Sonoma. Yolo. Del Norte. Humboldt. Mendocino. Fresno. Kern. Kings. Madera. Mariposa. Merced. San Joaquin. Stanislaus. San Diego. Imperial. Shasta. Siskiyou. and Trinity Counties. 974 pp., 275 illustrations. cloth	2.00
Chapters of the State Mineralogist's Report. Biennial Period, 1915–1916. Fletcher Hamilton:	
**Mines and Mineral Resources. Alpine. Inyo and Mono Counties. 176 pp.. paper	----
**Mines and Mineral Resources, Butte. Lassen, Modoc. Sutter, and Tehama Counties. 91 pp., paper	----
Mines and Mineral Resources. El Dorado. Placer, Sacramento, and Yuba Counties. 198 pp., paper	.65
Mines and Mineral Resources. Monterey. San Benito. San Luis Obispo. Santa Barbara. and Ventura Counties. 183 pp., paper	.65
Mines and Mineral Resources. Los Angeles. Orange. and Riverside Counties. 136 pp.. paper	.50
**Mines and Mineral Resources. San Bernardino and Tulare Counties. 186 pp.. paper	----
Fifteenth Report of the State Mineralogist. for the Biennial Period 1915–1916. Fletcher Hamilton. 1917:	
A General Report on the Mines and Mineral Resources of Alpine. Inyo. Mono, Butte. Lassen. Modoc. Sutter. Tehama. Placer, Sacramento. Yuba. Los Angeles. Orange. Riverside. San Benito. San Luis Obispo. Santa Barbara. Ventura, San Bernardino and Tulare Counties. 990 pp., 413 illustrations. cloth	3.75
Chapters of the State Mineralogist's Report. Biennial Period 1917–1918. Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County. 188 pp., paper	.50
Mines and Mineral Resources of Sierra County. 144 pp.. paper	.50
Seventeenth Report of the State Mineralogist. 1920. Mining in California during 1920. Fletcher Hamilton; 562 pp., 71 illustrations. cloth	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly, January, April, July, October, 1925, per copy	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924	Free
January, February, March, April, May, June, 1925	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899. 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps	$0.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905. 168 pp., 54 illustrations	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916. 47 pp.	$0.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted	2.50
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring. 1918. 248 pp., 51 illustrations, 5 maps, paper	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley, 1925. 140 pp., 62 photographs, 11 plates, cloth	1.00
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916–1917, by R. P. McLaughlin. 1918. 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917–1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	----
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello. 1920. 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth	1.00
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley, 1923. 188 pp., paper	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley, 1924. 162 pp., paper	Free
Bulletin No. 95. Geology and Ore Deposits of the Randsburg Quadrangle, by Carlton D. Hulin, 1925. 148 pp., 5 maps and numerous plates, cloth	2.00
Bulletin No. 96. California Mineral Production for 1924, by Walter W. Bradley, 1925. 173 pp., paper	Free

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	----
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
**Preliminary Report No. 8. A Review of Mining in Caifornia During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----

MAPS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County	$0.25
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County	----
Register of Oil Wells, with Map, Los Angeles City	----

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California, Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted	.50
**Unmounted	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	.25
**Map of Trinity County	----
**Map of Tuolumne County	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County	.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emido and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75

OIL FIELD MAPS—Continued.

	Price
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	$0.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	1.00
Map No. 30—Rosecrans, Los Angeles County	1.00
Map No. 31—Inglewood, Los Angeles County	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

INDEX.

Page

- A. B. C. Gem Mine 362
- Abe Lincoln Placer Mine 462
- Abel, W. Cook Placer Mine 462
- Acachuma Mine 542
- Adjudicated mining terms and phrases 77–121
- Administration Division 122, 258, 397, 573
  - Mails and files 122, 258, 397, 573
  - New publications 122, 258, 397, 573
  - Personnel 122, 258, 397, 573
- Advance Mine 430
- Ager Coal Mine 425
- Agricultural lime:
  - in San Diego County 372
  - in Ventura County 240
- Alameda County, Oil field development in 563
- Aldrich and Hegler Mine 453
- Alice and Modoc Mine 532
- Alisal Ranch Deposit 42, 56
- Alta California Mine 287
- Alviso and Sunshine Claims 507
- Amblygonite (see Lithia).
- American Asbestos and Manufacturing Company 164
  - Asbestos Products Company 164
  - Encaustic Tiling Company 358, 375
  - Gold Dredging Company 162, 191
  - Lithia and Chemical Company 374
  - Pottery Company 354
  - River Sand and Gravel Company 16
- Ames Copper Prospect 427
  - Prospect 431
- Analysis:
  - of amphibolite schist from Calaveras County 169
  - of clay from El Cajon Kaolin Deposit 354
  - of clay from Loofburrow Deposit 302
  - of coal from Humboldt County 303, 304
  - of dolomite from Aumaier and Roderjuez deposit 513
  - of granite from McKoon Silver-gray Granite Quarry 367
  - of iron ore from McKinney Iron Mines 521
  - of limestone from Humboldt County 318
  - of limestone from Tassajero Group 522
  - of limestone from Ventura County 239, 240
  - of mineral water from springs of Santa Barbara County 554–556
  - of natural cement rock from Ventura County 240
  - of ore from Friday Mine 352
  - of quartz from Hammond Property 217
  - of salts from Soda Lake 536
  - of silver-gray granite from Eucalyptus Ranch Quarry 365
  - of Ventura Velvet Molding sand 241
  - of volcanic ash from Weatherby Ranch 324
  - of water from Buckman Springs 381
  - of water from El Granito Mineral Springs 381
  - of water from Merry Hill Mineral well 525
  - of water from Nuvida Mineral Spring 382
  - of water from Warner's Hot Spring 382
- ancient channels of the Duncan Canyon Region:
  - Placer County 275–280
  - map of 276
  - mines 276–280
  - topography and geology 276
- Anderson Placer 462
- Anderson & Hardison Pressed Brick Company 237
- Angels Greenstone Company 168
  - Marble Quarry 168
- Antimony:
  - in Merced County 175
  - in San Luis Obispo County 504
- Antone Sandstone Quarry 497
- Apex Mine 144
  - Mining Company 144

Page
Arastra Flat Group of Claims 229
Argilla Group of Claims 239
Arington and Putman Gravel Pit 196
Arroyo La Cruz deposit 510
Arsenic:
  in Monterey County 28
  in San Diego County 329
Asbestos, 1924 production 259
  in Calaveras County 163
  in Merced County 175
  in Monterey County 28
  in San Luis Obispo County 504
  in Siskiyou County 420
  Producing Company of California 164
Asphaltum:
  in Monterey County 28
  in Santa Barbara County 545
  in Ventura County 232
Associated Development Company 10
Atlas Rock Company 217
Aumaier and Roderjuez Dolomite deposit 513
Aurora Hydraulic Mine 292

Bachman Mine 144
Bailey Mine 431
Baker Mine 431
Bald Mountain Mine 276
Baldwin Group 431
Ball Mine 431
Ball & Goforth Prospect 431
Ballena Placer 332
Ballingal Placer 464
Banes Soda Springs 45
Bank Mine 530
Barite:
  in Calaveras County 164
  in Humboldt County 300
  in Merced County 175
  in Monterey County 28
  in Santa Barbara County 545
  in Stanislaus County 204
Barium Products in Stanislaus County 204
Bark House Creek Placer 464
Barnum Brothers Copper Prospect 427
  Quartz Mine 431
Barona Mine 330
Barry & Woodfill Placer Mine 489
Barton Claims 427
Barytes (see Barite).
Bay Development Company 55
Bear Creek Placer Mine 541
  Den Claim 457
Beaudry Placer Mine 464
Becket, J. F., bituminous rock deposit 505
Bedell, L. E., copper claims 31
Beeman silica deposit 375
Belle Josephine Mine 464
Bellota Gravel Pit 196
Bence Mine 145
Bender Mine 431
Bennett Company 467, 470, 479, 480
Bent Bros., Inc., Gravel Pit 182
Benton Ranch quicksilver deposit 530
  silica deposit 375
Berg, George, copper prospect 179
Bernardo Granite Quarries 363
Beryllium in San Diego County 329
Bibliography of molding sands 254
  of Sacramento County 22
  of Siskiyou County 498
Big Bar and Big Bar Annex Mine 308
  Bend Mine 464
  Four Group of Claims 229

Page
Big Ledge Mine 431
  Nugget Placer Mine 462
  [illegible] Mine 465
  [illegible] Iron Deposit 162
Bishop's Peak Quarry 537
Bismuth in San Diego County 330
Bitterwater Spring 524
Bituminous rock, 1924 production 259
  in [illegible] [illegible]
  in [illegible] 545
  in [illegible] [illegible]
[illegible] [illegible]
Black Bear Quartz Mine 431
  Diamond Gold Quartz Mine [illegible]
  Hawk, Hidden Treasure and Triangle claims 432
    Mine 534
  Lead Mine 465
  Mountain Arsenic Company [illegible]
    Mine 329
[illegible]
  in Del Norte County [illegible]
  in Humboldt County 300
  in [illegible] [illegible]
  [illegible] Mine [illegible]
[illegible], cited 170
[illegible] Placer [illegible]
[illegible] Mine [illegible]
[illegible] Mine [illegible]
[illegible] [illegible]
  [illegible] Mine 465
  [illegible] Mine 465
  [illegible] Mine [illegible]
    [illegible]
  [illegible] [illegible]
  [illegible] Mine [illegible]
  [illegible] Mine [illegible]
    [illegible] [illegible]
  [illegible] Mine [illegible]
[illegible] Mine 145
[illegible] Mine [illegible]
[illegible] [illegible]
  [illegible] deposit [illegible]
  Mine 433
[illegible] Mine 309
[illegible] Quartz Mine 308
[illegible] 1924 production 260
[illegible] 233-236
[illegible] 375
[illegible] Spring 380
[illegible] Mine 433
[illegible] Consolidated Mine 145
  Mine 145
[illegible] Consolidated Gold Mining and Milling Company 334
    Mines 334
    [illegible] 331
    Placer Mine 466
  [illegible] Mine 466
  Prospect 434
[illegible] deposit 351
Bowers, Stephen, cited 59, 67
Bowersox Mine 466
Boyle Mine 434, 453
Bradley Spring 381
  Walter W. 122, 123, 258, 397, 573
  W. W., cited 212, 495
  & Welch Placer 489
Brazil Mine 466
Brea Canyon Mine 232
Brewery Mine 38
Briceland Estate gas well 320
[illegible]
  in Humboldt County 301
  in Merced County 175
  in San Diego County 355

Page

Brick—Continued.
    in San Joaquin County 188
    in San Luis Obispo County 505
    in Ventura County 237
    and tile, 1924 production of 578
Briggs Mine 181
Brooklyn Mine 38
Brown Bear Mine 434
    Eagle group 41
    group of claims 334
    & George Mine 466
Buckeye Flat Mining Company 15
    Manganese Mine 212
Buckman Springs 381
Buclimo Mining Company 39
Budan Springs 526
Buena Vista Mine 533
Building stone in San Luis Obispo County 537
Bullion, Dealers in, must take out licenses 390–396
    Hill Mine (see Washington Mine).
Burns Placer Mine 466
    property 22
    Ranch, asbestos on 421
    William, Placer (see Joubert Placer Mines).
Burro Asbestos Mine 28
Burroughs Silica Mine 375
Burton claim 434
    Mound Sulphur Springs 553
Bush, R. D. 72, 246, 383, 563
Bushnell Mine 39
Butler, E. L., Ranch 15
Buzzard Hill Mine 434
    , Inc. 446
    Mine 428
Bythenia Springs 553

Cady, C. C., Asbestos prospect 421
Caen Quarry 537
Calaveras Cement Company 165
    Copper Company 143
    County 135–172
        bibliography of publications on 141
        geography of 135
        geology of 140
        mineral resources of 136
        table of mineral production 139
    iron deposit (see Big Trees deposit).
    Mine 150
Calcite in Merced County 177
California-American Marble Company 168
    Asbestos Company 164
    Clay Products Company 354, 355
    Foundries, Directory of 568–572
    Foundry sands 251–257
        bibliography on 254–255
        core sand 252
        fire sand 253
        molding gravels 252
        molding sand 252
        parting sand 253
        steel sand 253
        tests of, Table 256
    Kieselguhr Company, Inc. 32
    Magnesite Company 208
    Ocher Mining Company 213
    –Oregon Metals Company 301
    Pottery Company, The 175, 179
    Pottery Company (see also Valley Spring Clay Pit).
    Refining Company 360
Californite in Siskiyou County 493
Calmo Mining and Milling Company 161
Camanche Gold Dredging Company 162
Cambria Mine 530
Cameta Warm Spring 524

Page

- Campbell, Forest L. 126
  - M. R., cited 29
  - Placer Mine 466
- Campo iron deposit 350
  - molybdenum deposit 351
- Cannon & Company molding sand 21
    - Pottery 2
- Canon Bar Mine 309
  - Del Diablo Mine 232
- Cape Cod Mine 435
- Capistrano limestone deposit 68
- Capitol Sand and Gravel Company 17
- Capitola Mine 530
- Carmel Coal Mines 30
  - Development Company 54
- Carpenter & Robertson Mine 466
- Carpinteria Clay Products Company 546
- Carson Hill Gold Mines, Inc. 146
    - Mining Company 146
  - Mine 531
  - Quicksilver Mining Company 532
- Casey & Bach claim 142
- Cassadoga Mine 435
- Castac Mine 230
  - Mining Company 230
- Castro Mine 507
- Cavanaugh Mine 309
- Cecila Barrett placer property 15
- Cecilville Placer Mine 466
- Celite Products Company 548
- Cement, 1924 production 260
  - in Calaveras County 165
  - in Merced County 177
  - rock, Natural, in Ventura County 240
- Centerville iron deposit 317
- Central Mine 435, 458
  - Petroleum Company 11
  - property 435
  - Supply Company (see Templeton Sand Plant).
- Champion Mine 435
- Chaparral Hill Group 151
  - Operating Company 151, 154, 160
- Chapman Mine 150
  - prospect 436
- Chastain, Jason, limestone deposit 492
- Cherry Hill Mine 436
- Chili Gulch Mining Company 161
- China Paul Mine 447
- Cholame Grant 42
- Chorro Creek Mine 507
- Christianson, Nels, Mine 293
- Chromite, 1924 production 260
  - in Calaveras County 165
  - in Del Norte County 285
  - in Humboldt County 301
  - in Monterey County 29
  - in San Luis Obispo County 507
  - in Santa Barbara County 545
  - in Siskiyou County 421
  - in Stanislaus County 205
- Cinnabar (see Quicksilver).
- Claim Holders Association (see Sanger Peak Copper).
- Classic Hill Mine 466
- Claus group (see Rinconada Mine).
- Clay:
  - in Calaveras County 167
  - in Del Norte County 287
  - in Humboldt County 302
  - in Merced County 177
  - in Monterey County 29
  - in Orange County 64–66
  - in San Diego County 354
  - in San Joaquin County 190

Page

Clay—Continued.
  in San Luis Obispo County 505
  in Santa Barbara County 546
  in Stanislaus County 204
  in Ventura County 236
  Industry of Sacramento County 2
  pottery, 1924 production of 579
Clear Creek Mine 428
Cleaver Mine 436
Cleveland-Pacific Mine 335
Clover Flat Placer Mine 309
Coal, 1924 production of 579
  in Del Norte County 285
  in Humboldt County 303–304
  in Merced County 179
  in Monterey County 29–31
  in Orange County 67
  in San Joaquin County 190
  in San Luis Obispo County 510
  in Siskiyou County 425–426
  in Stanislaus County 205
Coast Rock and Gravel Company 19
Cobalt in Calaveras County 142
Colemanite in Ventura County 233–236
Colorado Chrome Mine 507
Columbia Mine 437
Columbus Mine 234
Colusa County, Oil field developments in 383
Commodore Mine 437
Comparison of mineral industry with agriculture 575
Concrete, Pumice aggregate in 495
Conrad, Geo. W., asbestos deposit 421
Consolidated Bituminous Rock Company 505
  Chemical Company 535
Contact Mine 230
  & Bonanza claims 437
Continental Shale Products Company 557
Conzetti Placer Mine 467
Cook, Abel W., Placer Mine 462
  Mineral Spring 320
Cooley Ranch, Coal on 426
Copper, 1924 production 398
  Creek Mine 286
  in Calaveras County 142
  in Del Norte County 287
  in Humboldt County 305–308
  in Merced County 179
  in Monterey County 31
  in San Diego County 330
  in San Luis Obispo County 510–512
  in Santa Barbara County 541
  in Siskiyou County 426–429
  King Mine 541
  Mountain group (see Barnum Bros. Copper prospect).
Corey Brothers Mine 438
    prospect 437
Costs, Mining, at Carson Hill Gold Mines, Inc. 150
Covas Granite Quarry 364
Cowgill Quicksilver Mine 495
Coy, Owen C., cited 281, 295
Crapo Placer Mine 467
Crary, S. R., Mine 487
Crawfish Gulch Mine 438
Crawley Mine 437
Crimson Copper Group 305
Crocker properties 192
Croesus Placer Mine 467
Cronin Placer Mine 467, 471
Croton Bar Mine (see Bondo Mine).
Crushed rock (see also Stone, Miscellaneous), 1924.
      production of 585–587
Cub Bear and Blue Jeans prospects 438
Cunningham & Son sand plant 71
Cypress Chrome Mine 507
  Mountain group 530

Page
Daley Copper Mine 330
  Sand and gravel plant 377
Dave Savoy Placer Mine 291
Davis Consolidated Mines 467
  Estate, Reeves, Californite on 493
  Mine (see Clear Creek Mine).
Day, David T., cited 284
  Hawk Mine 291
Dealers in gold-silver ores and bullion must take out licenses 390–396
Deer Park limestone deposit 370
    mining district 331
  Trail Mine 530
Dehesa Cornwall Stone deposit 358
Delaney group 309
Del Norte County:
  geography 281
  geology 282
  mineral resources 282–294
  table of mineral production 284
Del Monte Properties Company 54
Demarest Mine 151
Denny Bar Company 449
Descanso Mine 335
Deterton iron deposit 162
Dewey Mine 438
Diamond Creek Cinnabar Company 293
Diatomaceous earth:
  in Merced County 181
  in Monterey County 32–36
  in San Joaquin County 190
  in San Luis Obispo County 512–513
  in Santa Barbara County 547–552
  in Siskiyou County 429
  in Stanislaus County 206
  in Ventura County 238
Dick Morris Placer 469
Dietrich, W. F., cited 505
Dillon Creek prospects 428
Direct steel process of Wakama Iron and Steel Company 515–518
Directory of California Foundries 568–572
District Reports of Mining Engineers 1–71, 135–245, 275–382, 413–562
Division of Minerals and Statistics 123–125, 259–266, 398–402, 574–587
  1924 production statistics 259–265, 398–402, 574–587
  estimate of 1924 output 123
  summary for 1924 574–577
Dixie Queen Mine 277
Doctor Rock group 287
Doggett Mine 469
Dolan's Hot Springs 45
Dolomite, 1924 production 261
  in Monterey County 36
  in San Luis Obispo County 513
Dominion Mining Organization, Inc. 151
Dos Cabezas feldspar deposits 359
  limestone deposit 370
  silica deposits 375
Doty group 531
Double Eagle and Little Quartz claims 438
Douglas gem claim 362
Dredging, Gold
  in Calaveras County 162
  in Sacramento County 12
  in Siskiyou County 490–491
Drift mines in Sacramento County 15
Dr. Young Hydraulic Mine 292
Duncan Canyon Region, Placer County, Ancient channels of 275–280
Dunnigan Placer 469
Dutro Mine 50
D–V–O Products, Inc. 204

Eagle Marble Quarry 168
    and Lime Company 168
  Mine 335, 545
Eakel, A. S., cited 283

Page
East Fork group 293
Easter Mine 438
Eastlick Mine 469
Easyz Bird Mine 152
Ebony Black Granite Quarry (see Stockdale Granite Quarry).
Echstine Clay deposit 29
Eclipse and Old Vet group 453
Ed Fletcher Jr. Mine 362
Edmundson & Sanford claim 485
Efman & Boorse prospect 428
El Bonito Springs Bottling Company 381
El Cajon Kaolin deposit 354
El Divisadero Chrome Mine 507
El Encino Gravel Mine 161
El Granito Mineral Springs 381
Eliza Mine 439
Elizabeth and Winona group 531
Elk and Landslide claims 336
Elkhorn Hydraulic Mine 292
  Mine 309
Elliott Creek district, Siskiyou County 420
  Placer Mine 469
Ellis Mine (see Descanso Mine).
El Oro No. 3 Dredge 490
El Salto Chrome Mine 507
Elsemore, W. C., rock-crushing plant 321
El Toro deposit 68
Empire Mine 152
Employment service 133, 274, 411, 595
  positions wanted 133, 274, 411, 595
Encinitas Copper Mine 331
    Company 331
Engelhart Paving and Construction Company 321
Enterprise group 439
Erickson Quarry 562
Escondido Mine (see Cleveland-Pacific Mine).
Esmeralda Extension and Tellurium claims (see Bence Mine).
  property, Lepidolite in 373
Esperanza Mine 230
  (see also Boston Mine).
Ester group 336
Eucalyptus Ranch Quarry 364
Eureka Brick and Tile Company (see Thompson Brick Company).
  and W J. D. prospects 439
Evans manganese deposit 523
  Ranch chrome deposit 507
Evening Star Mine 439, 458
Evergreen Placer 41
Everton Pocket Mine 450
Ewing, Ed. Diatomaceous earth prospect 429
Expansion group 336
Extraction of shale oil 557

Fagundez Mine 439, 445
Fairbanks, H. W., cited 59, 67, 332, 500
Fairchild prospect 439
Falcon prospect 439
Featherstone Insulation Company 549
Feldspar:
  1924 production of 579
  in Monterey County 36
  in San Diego County 358
Felts Mineral Spring 320
Fenn, R. G., gravel plant 379
Fenton-Parker Materials Company 377–379
    Chollas Valley plant 377
    Murray Canyon plant 378
    Otay plant 377
    Sand plant 379
    Spring Valley plant 379
Ferrell deposit 512
Fighting Bob No. 1 claim 41
Finnegan Mine 153
Fiock Bros. Quarry 497

Page
Fippen & Hayden Mine 466
lead ore in 491
Firebug prospect (see Eureka and W. J. D. prospects).
Fir Tree Placer Mine 470
Fish group 153
Flag prospect 439
Fleetwood and Nannie S. Mine 439
Fletcher Jr., Ed., Mine 362
Florence Placer Mine 310
Foley Mine 230
Folsom Granite Quarry 16
Ford Mine (see Apex Mine).
Forest Creek Mining Company 153
Forks of Salmon River Mining Company 485
Forks Placer Mine 470
Fortner Ranch manganese 163
Fossiliferous limestone in Ventura County 240
Foundries, California, Directory of 568–572
Foundry sands, California 251–257
Frances group 336
Francis Cleaner Mine 537
Frank, John, Mine (see Gold Bank Mine).
Peters Gas Well 320
Zarr Copper Mine 288
Franklin Mine 440
Franks & Moncton Mine 440
Frazer Mine 231
Frazier Mine 235
Placer Mine 471
Free Coinage Mine 336
Fremont Peak, Barite on 28
French Hill Chrome Mine 286
Mine 292
Fresno County, Oil field development 72, 246, 383, 563
Friday Copper Mining Company 330, 352
Mine 330, 352
prospect 286
Froom, Mrs., Ranch deposit 507
Fuels in Sacramento County 10
natural gas 11
petroleum 10
Fuller's earth, 1924 production of 261
in San Diego County 360
Gabbro, Orbicular, in San Diego County 369
Galena Mine 440
Gallia Placer Mine 471
Garber Brick and Tile Company 65
Garden Grove Sand and Gravel Company 71
Garnet in Monterey County 37
Garretson Springs 493
Gas (see Natural Gas).
wells in San Joaquin County 195
Gates, Frank A., gravel plant 562
Gearheart Placer 472
Geeshan & Kellner Placer Mine 473
Gem materials:
in Del Norte County 290
in Humboldt County 308
in San Diego County 329, 361
in Siskiyou County 493
Gems, 1924 production of 261
General Petroleum Company 360
George Cook Placer Mine 292
Mine 531
Washington Placer claims 292
and Brown Mine 466
Gettysburg Silver Mining Company 321
Gibson Bar Drift Mine 473
Gilfeather group 440
Gilta Quartz Mine 440
Glass manufacture in San Joaquin County 191
Glenn Consolidated Mine 278
Gloria Copper claim 511
Goddard-McKay Mines Company (see Chapman Mine).

Page

- Gold, 1924 production of 398
  - Bank & John Frank Mines 489
  - Bank Placer Mine 473
  - Crown group 337
  - discovery in 1841 in Ventura County 229
  - dredging in Siskiyou County 490–491
  - Hill Mine 441
    - Placer Mine 473
  - in Calaveras County 144–162
  - in Del Norte County 290–293
  - in Humboldt County 308–317
  - in Merced County 181
  - in Monterey County 37–42
  - in Orange County 59–62
  - in Sacramento County 11–16
  - in San Diego County 331–349
  - in San Joaquin County 191
  - in San Luis Obispo County 514
  - in Santa Barbara County 541
  - in Siskiyou County 430–491
  - in Stanislaus County 206
  - in Ventura County 229–232
  - Knoll Mining Company 153
  - Leaf Placer 473
  - Run Mine 441
  - -silver ores, Dealers in, must take out licenses 390–396
  - Standard and North Star Mines 337
- Golden and Eveleth Mine 441
  - Bloom group of claims 231
  - Chariot Mine 337
    - Mining Corporation 337
  - Eagle claim 441
    - Mine 308, 440
  - Nugget Mine (see Elliott Placer Mine).
  - Rod Mine 310
  - Rule and Scott Bar claims 474
  - Seal claim 441
  - West prospect 441
- Goldman, M., clay land 179
- Good Brothers claim (see Fighting Bob No. 1).
  - Luck Mine 339
- Goodman prospect 441
- Goodwill Copper Mine (see Los Osos Mine).
- Gorda Mine 39
- Gould Mine 533
- Gragg, Hazzard, deposit 512
- Grand Central Sulphur Spring 524
- Granite:
  - 1924 production of 580
  - in San Diego County 363–368
  - in Siskiyou County 491
  - Mountain Mine 339
  - Rock Company (see Templeton sand plant).
- Graphite:
  - in Humboldt County 317
  - in San Diego County 369
- Great Northern Quicksilver Mine, Inc. 495
- Green Mountain Mine 170
    - Extension claim 171
      - Mine 161
- Greening, Scott, Claims, californite on 493
- Grey Eagle Mine 428
- Grider Mine 474
- Griffin Onyx Marble Quarry 493
- Grinding-mill pebbles (see Stone, miscellaneous).
- Grizzly Gulch Mine 441
- Grove & Sons gravel plant 379
- Guadalupe copper claim 511
- Guerra deposit 551
- Guerro copper claim 511
- Gumboot prospect 441
- Gypsum Canyon deposit 67
  - 1924 production of 261
  - in Orange County 67

Page

- Gypsum Canyon Deposit—Continued·
  - in San Joaquin County 191
  - in San Luis Obispo County 515
  - in Santa Barbara County 552
  - in Stanislaus County 208
  - in Ventura County 239

- Haley, Chas. S., cited 285
- Hammer Placer Mine 474
- Hammond claims 31, 40
- Hammond's silica property 217
- Hansen, John, gravel plant 379
  - Mine 442
- Hard Climb prospect 278
- Harder, E. C., cited 520, 521
- Hard Luck Mine 290
- Hardscrabble prospect 442
- Hardy Mine 154
- Harvey Ranch molybdenite deposit 351
- Hatton Ranch deposit 53
- Haw manganese claim 319
  - Quarry 321
- Hawkins chrome deposit 286
  - Gold Mining Company 154
  - group 154
- Hayden & Fippin Mine 466
- Hazel Mine 442
- Hazzard Gragg deposit 512
- Hearst Ranch, manganese on 523
- Heaton, R. C., Mineral water well 525
- Hegler Mine 443
  - & Aldrich Mine 453
- Heins Lake clay deposit 29
- Helms Soda Springs 45
- Hematite:
  - in Del Norte County 293
  - in Humboldt County 317
  - in San Joaquin County 191
  - in Stanislaus County 208
- Hercules group of claims 362
- Hesperides Mining Company 169
- Hickey Mine 443, 467
- Hicks Mine 443
- Hidden Treasure claim 432
- Higgins Mine 545
- High-grading Act 390–396
- High Peak Mine 339
  - Plateau group 286
- Highland Mine 443
  - prospect 443
- Hill, J. M., cited 24, 25, 37, 38, 39, 40, 41
- Himalaya property, Lepidolite in 373
- Hittell, T. H., cited 229
- Hoboken Mine 444
- Hobson, W. K., copper claims 511
- Hogan Quarry 562
- Hollister Estate Company (see Salsipuedes Ranch deposit; also Las Cruces Hot Springs).
- Holmes Ranch mineral paint 168
- Homestake Consolidated Mines, Inc. 444
  - Mine 444
- Hood, George, crushed rock plant 294
- Hoosier Hill Placer 474
- Hopkins, F. C., Placer Mining Company 333
- Horner, R. R., cited 284
- Horse Mountain Copper Company 301, 306
  - district 305–308
- Hot Springs on North Fork of Little Sur River 45
- Houts, W. A., clay deposit 167
- Howard, Henry claims, Californite on 492
  - Mine (see Plaskett).
- Huer-Huero Springs 525
- Humboldt artesian mineral well 320
  - County:
    - geography 295
    - geology 295

Humboldt County—Continued. Page
   list of coal occurrences in 303
   mineral resources 295–324
   table of mineral production 298
Humpback Quartz Mine 445
Hunt, A. N., Quarry 323
Hunters Luck claims 288

Iaqua Medicinal Spring 320
Ida May Quartz Mine 445
Imperial Heights Mine 474
  Mining Company 339
Incello Company, The 512
Independence Mine 446
Indian Creek Gold Mining Company 155
   Mine (see Golden Eagle Mine).
Industrial minerals, in Calaveras County 163–172
International Gold Mines Company 341
Inyo Mine 447
Ireys black granite deposit 365
Iron:
  in Calaveras County 162
  in Del Norte County 293
  in Humboldt County 317
  in San Diego County 349
  in San Joaquin County 191
  in San Luis Obispo County 515–522
  in Siskiyou County 491
  Master group of claims 350
Ironsides Mine 447
Iridium (see platinum metals).
Isaac Minor Quarry 323
Isabel Dredge 162
Isabella Copper Mine 429
Isham's Spring (see Nuvida Mineral Spring).

Jackson Mine (see Fleetwood and Nannie S. Mine).
Jacoby Creek quarry 323
Jacquemart Hydraulic Mine (see Gallia Placer Mine).
Jacumba Hot Springs 382
  manganese group 350
Jason Chastain limestone deposit 492
Jasper in San Diego County 369
Jens Quarry 33
Jillson Mine 442
Joe Ramus Placer 469
Johe Ranch deposit 507, 523
John Frank and Gold Bank Mines 489
Johnson Bros. feldspar deposit 37
Johnson, H., asbestos claims 421
   chromite 424
  & China Paul Mine 447
Jolly Tar Mining Company (see Demarest Mine).
Jolon district, Monterey County 41
Jones & Klingers gravel plant 380
Jose copper claim 179
Josephine group 531
  Mine 532
Joubert Placer Mines 474
Judson Ranch molybdenum deposit 351
Julian mining district 331
Jumbo Mine 447

Kaiser Paving Company's quarry 498
Kane Graphite Mine 369
Kangaroo Mine 448
Karl Mine 531
Katie May Mine 448
Kaufman, E. E., cited 575
Kaus Placer Mine 292
Kavanaugh, Barney, diggings (see Park & Brown Mine).
Kay, C. B., ornamental sandstone deposit 493
Kearsarge & Pilot Knob claims 456
Keiselguhr Company of America (see Celite Products Company).
Kellner & Geeshan Placer Mine 473

Page
Kellogg Ranch deposit 43
Kentuck S Mine 340
Kern Construction Company, A. D. 294, 323
  County, Oil field development in 72, 246, 383, 563
Kessler onyx marble deposit 527
  Springs 525
Keynote group 448
Keystone Mine 531
King Solomon Mine 448
Kings County, Oil field development in 73, 384
Kinkaid prospect 448
Kiser Ranch, magnesite on 523
Kismet group 531
Klamath group 448
  Hot Springs 493
  River district 418
    Mine 310
Klau Mine 531
Klondike group (see Schofield Copper Mine).
Kunz, G. F., cited 171

La Bolsa Tile Company 65
Laboratory 124, 266, 403, 588
Ladd Canyon deposit 68
  Mine 192
La Grange Gold Dredging Company 207
Laguna mining district 331
  Ranch deposits 542, 546
    Mine 541
La Habra Sand and Gravel Company 71
Laidet soapstone property 171
Laizure, C. McK. 23, 173, 184, 200, 281, 295, 499
Lakeside feldspar deposit 359
  lime and marl deposit 373
  silica deposit 375
Lakeview group of claims 350
La Laguna Ranch chrome deposit 546
La Libertad Mine 532
Lamphear Mine 155
Landslide claim (see Elk and Landslide claims).
Lanky Bob Mine 449
La Perin copper group 305
Lapis sand plant 55
La Primea Chrome Mine 507
Las Aguas Calientes (see Warner's Hot Springs).
La Salle Canyon deposit 551
Las Cruces Hot Springs 554
Last Chance Mine 161, 341
Late Ocher Mine 168
  Ranch sandstone 171
La Trinidad Chrome Mine 507
Lead, 1924 production of 399
  in Orange County 62–64
  in San Diego County 350
  in Siskiyou County 491
Leebrick Mine (see Kane Graphite Mine).
Lee Quarry 537
Lehman Mine 530
Lepidolite (see Lithia).
Liberty Bond group 429
  Manganese Mine 213
Library 126–131, 267–272, 404–409, 589–593
  Official publications received 126, 267, 404, 589
Licenses required by dealers in gold-silver ores and bullion 390–396
Lime, 1924 production of 580
Limestone:
  1924 production of 580
  in Calaveras County 167
  in Humboldt County 318
  in Monterey County 42
  in Orange County 68
  in San Diego County 369
  in San Joaquin County 191
  in San Luis Obispo County 522

Page

- Limestone—Continued.
  - in Santa Barbara County 552
  - in Siskiyou County 492
  - in Ventura County 239–240
- Lindauer & Sons sand plant 71
- Lind, J. C., limestone deposit 552
- Liscom Hill barite deposit 300
- List of coal occurrences in Humboldt County 303
- Lithia, 1924 production of 262
  - in San Diego County 373
- Little Bonanza Mine 532
  - Bonsa Mine 449
  - Gem and Snowflake Quartz claims 457
  - Klondike Mine 308
  - Quartz claims 438
  - Queen (see Morrison & Carlock Mine).
  - Three Gem Mine 362
- Livingston & Everton Pocket Mine 450
- Lode Mines (see Gold).
- Logan, C. A. 1, 135, 275, 413
  - cited 293, 321, 528
- London Chrome Mine 508
- Lone Pine Mining and Milling Company 346
- Long Tom Placer group 476
- Loofbourrow clay deposit 302
- Lookout group 341
- Lopez Canyon group 522
- Los Angeles County, Oil field development in 73, 247, 384, 564
  - Field Division 58–71, 223–245, 325–382, 539–562
  - Pressed Brick Company 66, 355
- Los Banos gravel pit 183
- Los Burros district, Monterey County 37
  - geology of 37
  - mines of 38–41
- Los Olivos deposit 546
- Los Osos Copper Mine 511
- Los Prietos Mines 543
- Los Vergeles Ranch deposit 43
- Lowden Placer 476, 477
- Low Divide Mine (see Copper Creek Mine).
- Lowell & Mosher claim 450
- Lower Siskiyou Mine 480
- Lucky Baldwin claim 341
  - Bob Drift Mine 477
  - Jack group 508
  - Strike Mine 450

- Madden group 341
- Madrone Mine 533
- Magazines on file, List of 130, 271, 408, 592
- Magnesite, 1924 production of 262
  - in Humboldt County 319
  - in Merced County 181
  - in Monterey County 43
  - in San Luis Obispo County 523
  - in Stanislaus County 208–210
- Magnesium salts, 1924 production of 262
- Magnetite in Humboldt County 317
- Mahoney Mine 533
- Mails and files 122, 258, 397
- Majors & Wurst limestone deposit 492
- Malloy Quartz Mine 450
- Malone Mine 429
- Maltos & Mexican claims 155
- Manchester Mine 40
- Manganese:
  - 1924 production of 581
  - in Calaveras County 163
  - in Humboldt County 319
  - in Merced County 181
  - in San Diego County 350
  - in San Joaquin County 191–193
  - in San Luis Obispo County 523–524
  - in Santa Barbara County 542
  - in Stanislaus County 210–213

Page
Manilla manganese property 163
Mann & Ross Drift Mine 477
Maple Creek coal deposit 303
Maplesden Mine 477
Map of Central California relative to natural gas 194
  of Duncan Canyon Region, Placer County 276
  of Horse Mountain copper properties 306, 308
Marble:
  in Calaveras County 168
  in Monterey County 42
  in San Diego County 369
  in Siskiyou County 492
  onyx, in Siskiyou County 493
Marden feldspar deposit 359
  silica deposit 376
Margaret & Lucky Baldwin claims 341
Mariposa Mine 40
Markeson Mine (see Bondo Mine).
Marks gravel pit 183
Marl:
  in San Diego County 372
  in Ventura County 240
Marquat Estate, antimony deposit 504
Marshall Mine 292
Mary Alma claim 477
Masonic Bar claims 477
Mason Valley Mine Company (see Grey Eagle Mine).
Matilija group of claims 240
McCann Placer 479
McClaughry group 450
McCook Placer 479
McGary Mine (see Chapman Mine).
McGilvray Raymond Granite Company 365
McKeen Mine 450, 453
McKenzie Mine 450
McKinney Iron Mines 518–521
McKoon Silver-gray Granite Quarry 367
McNeals Bar Mine 470
Meadows Gulch deposit 57
Medicine Rock Quarry 323
Melba group 342
Melones Mine 147
Melrose group 342
Melville property (see M. M. Mine).
Merced County 173–183
  geography and geology of 173
  mineral resources of 173
  oil field developments in 387
  table of mineral production 174
Merced River Gravel Company 183
Mercer Fraser Company gravel pits 323
Mercury (see Quicksilver).
Merry Hill mineral well 525
Metals Exploration Company (see Oceanic Mine).
Metals:
  in Calaveras County 142–163
  in Del Norte County 284–294
  in Humboldt County 300–324
  in Merced County 175–183
  in Monterey County 28–57
  in Orange County 59–64
  in Sacramento County 2–22
  in San Diego County 329–353
  in San Joaquin County 188–200
  in San Luis Obispo County 499–538
  in Santa Barbara County 541–544
  in Siskiyou County 414–498
  in Stanislaus County 204–222
  in Ventura County 229–232
Mexican Smelting and Refining Company (see Blue Ledge Mine).
Mica:
  in San Diego County 374
  in Ventura County 241
  lithia, in San Diego County 373

Page

Michigan-Salmon Hydraulic Mine 479
Middlemast chrome deposit 508
Midwinter & Modoc claims 456
Might, Wm., claims 450
Milburn-McAvoy group 543
Miller, E. F., quicksilver claims 302
Miller gravel pit 197
Milne & Reichman chrome deposit 424
Mineral industry:
  compared to agriculture 575
  per cent of total freight tonnage due to 575
  paint, 1924 production of 263
    in Calaveras County 168
    in San Diego County 374
    in Stanislaus County 213
    in Ventura County 241
  production:
    by counties 577
    by substances 576
    estimate of 1924 output 123
    in 1924 259–265, 398–402, 574–587
    tables:
      Calaveras County 138
      Del Norte County 284
      Humboldt County 298
      Merced County 174
      Monterey County 26
      Orange County 60
      Sacramento County 4
      San Diego County 328
      San Joaquin County 186
      San Luis Obispo County 502
      Santa Barbara County 541
      Siskiyou County 422
      Stanislaus County 202
      Ventura County 226
  Products Company 210
  resources:
    of Calaveras County 135–172
    of Del Norte County 281–294
    of Humboldt County 295–324
    of Merced County 173–183
    of Monterey County 23–57
    of Orange County 58–71
    of Sacramento County 1–22
    of San Diego County 325–382
    of San Joaquin County 184–200
    of San Luis Obispo County 499–538
    of Santa Barbara County 539–562
    of Siskiyou County 414–498
    of Stanislaus County 201–222
    of Ventura County 228–245
  springs:
    in Humboldt County 320
    in Monterey County 44–50
    in San Diego County 380–382
    in San Luis Obispo County 524–526
    in Santa Barbara County 553–556
    in Siskiyou County 493
  water:
    1924 production of 581
    in Calaveras County 168
    in Humboldt County 320
    in Monterey County 44–50
    in San Diego County 380–382
    in San Luis Obispo County 524–526
    in Santa Barbara County 553–556
    in Siskiyou County 493
Mining Engineers, District reports of 1–71, 135–245, 275–382, 413–562
  Law 77–121
  terms and phrases, adjudicated 77–121
Minnehaha prospect 496
Minor, Isaac, Quarry 323
Miscellaneous stone in Sacramento County 16

Page

- Mission Canyon deposit, 562
  - China Company, 355
- Mitchell, R. P., sand plant, 71
- M. M. Mine, 40
- Modoc Mine, 532
  - and Midwinter claims, 456
- Mok-Hill Mineral Springs, 168
- Molding sand:
  - 1924 production of, 585
  - in Sacramento County, 21
  - in Ventura County, 241
- Molybdenite:
  - in Calaveras County, 162
  - in Monterey County, 50
  - in San Diego County, 350
  - in Ventura County, 232
- Monarch iron deposit (see Detert deposit).
  - Quartz Mine, 450
- Moncton Mine, 440
- Monkey Creek Placer Mine, 292
- Montecito Barytes deposit, 545
  - Hot Springs, 554
- Monte Cristo group, 50
- Monterey Bay Salt Company, 53
  - Coal Company, 30
  - County:
    - geography, 23
    - geology, 24
    - mineral production, table of, 26
    - mineral resources of, 25–57
  - mineral well, 44
  - Mission Tile Company, 57
  - Products Company, 33
- Montezuma Mine, 342
- Montmorillonite in Santa Barbara County, 546
  - (see also Fuller's Earth).
- Monumental Consolidated Quartz Mine, 290
- Moore feldspar deposit, 359
  - Quarry, 537
  - Spring, 555
  - Thomas W., limestone deposit, 553
- Moraga Ranch deposit, 553
- More Ranch deposit, 551
- Morgan Brothers Mine, 495
  - Mine, 147, 292
- Morganza Drift Mine, 480
- Morning Star Placer Mining Company, 514
- Morrell Placer Mine, 292
- Morris clay deposit, 355
  - , Dick, Placer, 469
- Morrison & Carlock Mine, 450
- Morro Rock Quarry, 537
- Morrow group of mines, 64
- Morton clay deposit, 355
- Mosher & Lowell claim, 450
- Mountain Chrome Mine, 424
  - King group, 155, 452
  - Laurel Quartz Mine, 451
  - Lily Mine, 363
    - Quartz Mine, 451
  - View Springs, 320
- Mount Vernon Consolidated Mine, 452
- Mowhawk Mine, 156
- Muddox Pottery, 10
- Multum in Parvo Placer Mine, 480
- Municipal Baths Springs, 525
- Murray, J. J., asbestos claims, 421
- Muscio, A. A., Manganese deposit, 523
- Museum, 124, 266, 402, 588
- Mutual Chrome Mine, 508
- Myers Pit (see Miller gravel pit).
- Mykrantz feldspar deposits, 359
- Myrtle Creek Hydraulic Mine, 293

Page

- Nannie S Mine 439
- Napa County, Oil field development in 75, 387
- Napoleon Copper Mine 142–164
- National Brick Company 356
  - Cement Company 421
- Native Copper Company 31
  - Son Placer Mine 480
- Natomas Company of California 3, 13
- Natural cement rock in Ventura County 240
  - gas:
    - 1924 production of 581
    - in Humboldt County 320
    - in Orange County 68
    - in Sacramento County 11
    - in San Joaquin County 193–195
    - in Santa Barbara County 561
    - in Ventura County 242
- Navajo Mines 514
- Neilon & Putnam prospect 452
- Nels Christianson Mine 293
- Nelson Cooper Company gravel plant 380
  - and Sloan gravel plant 379
- Nevins magnesite deposit 43
- New county reports 1
- New Era Mine 480
  - Publications 122, 258, 397
  - York Mine 40, 452
    - -Calaveras Mine (see Sherman Ranch Mine).
- Newsom's Springs 525
- Newspapers on file, List of 131, 271, 409, 593
- Neys Springs 493
- Nickel, in Monterey County 50
  - in San Diego County 352
- Nigger Boy Mine 452
  - Hill Placer Mine 480
- Noble Mines 343
- Noce Mine 161
- Nolan Gulch Placer 481
- Nonmetals, in Calaveras County 163–172
  - in Del Norte County 284–294
  - in Humboldt County 300–324
  - in Merced County 175–183
  - in Monterey County 28–57
  - in Orange County 64–71
  - in Sacramento County 2–22
  - in San Diego County 353–382
  - in San Joaquin County 188–200
  - in San Luis Obispo County 499–538
  - in Santa Barbara County 545–562
  - in Siskiyou County 414–498
  - in Stanislaus County 204–222
  - in Ventura County 232–245
- Norcross Chrome Mine 508
- Nordheimer Placer Mine 481
- North Central Region, Siskiyou County 416
  - Hubbard Mine (see Ready Relief).
  - Star Mine 337, 453, 533
- Northern California Dredge Company 490
- N. T. U. Company, The 559
- Nuvida Mineral Spring 382

- Oak Bar Dredge 491
  - Bottom Placer Syndicate 481
  - Flat and East Fork groups 293
  - Grove Tungsten Mine 353
- Oakdale Ranch deposit 35
- Occidental group 288
- Oceanic Mine 533
- Ocean View Mine (see Plaskett).
- Ocher (see Mineral Paint).
- O'Donnell & Burns Mining Company 546
- Ohio Mine 453
- Oil (see Petroleum).

Page
Oil field development operations 72–76, 246–250, 383–389, 563–567
  in Alameda County 563
  in Colusa County 383
  in Fresno County 72, 246, 383
  in Kern County 72, 246, 383, 563
  in Kings County 73, 384
  in Los Angeles County 73, 247, 384, 564
  in Merced County 387
  in Napa County 75, 387
  in Orange County 75, 249, 388, 566
  in Riverside County 75, 388, 566
  in San Benito County 75, 249, 566
  in San Bernardino County 75, 249, 388, 567
  in San Diego County 75
  in San Joaquin County 388
  in San Luis Obispo County 75, 249, 388, 567
  in San Mateo County 75, 249, 388
  in Santa Barbara County 75, 250, 388, 567
  in Santa Cruz County 388
  in Tulare County 75, 388, 567
  in Ventura County 76, 250, 388, 567
  in Yolo County 76
 shale deposits of Santa Ynez River Region 561
  in San Luis Obispo County 528
  in Santa Barbara County 556–561
Oil wells in 1924, number of 401
Ojai Gypsum Mine 239
 Mine 233
Old Calaveras group 157
 Dominion Mine 64
 Highland Mine 443
 Stiff Mine 161
 Vet and Eclipse group 453
One Hundred Dollar prospect 453
O'Neill Ranch Placer 481
Ontario Springs 526
Onyx in Siskiyou County 493
 marble in San Luis Obispo County 527
 and travertine, 1924 production of 263
Opals in Calaveras County 170
Ora Anna Quartz Mine 291
Orange County Brick and Tile Company 66
  Coal Mining Company 67
  general description 58
  geology 58
  mineral resources of 59–71
   table of 60
  oil field development in 75, 249, 388, 566
  Rock Company, Inc. 69
Orbicular Gabbro in San Diego County 369
Orcutt Hydraulic Mine 310
 Placer Mine 482
Oregon Mine 41, 453
Oregonian group 450, 453
Orella Estate Quarry 562
Orestimba Mining Company 216
Oriental copper claim 288
 Quartz Mine 453
Oriflamme Mine 345
Orleans Bar Mine 310
Ornamental stones in Siskiyou County 493
Oro Fino Mine 231
 Grande Mine 453, 454
Osborne feldspar deposit 359
 silica deposit 376
Osceola prospect 455
Osgood Mine 454
Osmiridium (see platinum metals).
Otaylite (see fuller's earth).
Otay sand deposit 55
Outlook Mine 455
Overton Mine 455
Owens Mine 345
Owl claim 286

Page
Pacific Asbestos Corporation 164
  Clay Products Company 356
  Diatom Products Company 36
  Distributing Corporation (see Consolidated Chemical Company).
  Gold Mining and Milling Company (see Easyz Bird Mine).
  Rock Granite Company (see Angels Greenstone Company).
  Sanitary Manufacturing Company 358
    Porcelain Company 359
Paddy Cronin Mine 471
    Placer Mine 482
Paine Mine 482
Pala Chief Gem Mine 362
      Mining Company 362, 363
  lepidolite deposit 374
Paloma Mining Company 51
Panama pottery 7
Paradise Flat Placer Mine 482
Paraiso Hot Springs 45
Park & Brown Mine 279
Parker Brick Company's plant 547
  group 429
  Placer 482
Parkfield district, gold in 42
Paso Robles Hot Springs 526
    Mud Bath Springs 526
Patent Process claims of Wakama Iron and Steel Company 518
Patriquin-Gillett Quicksilver Mining Company 51
  Quicksilver Mine (see Paloma Mining Company).
Patton Mine 231
Paving block (see Stone, miscellaneous).
Peacock Mining Company 310–315
  sluice and riffle construction at 316
Pearch Creek prospect 308
  Mine 315
Pecho Warm Springs 526
Peg Leg Mine 424
Peirano soapstone property 171
Penn Mining Company's clay deposit 167
Pennsylvania Placer 482
Peoples Lumber Company brick and tile plant 237
Pereira group 508
Personnel, changes in 122, 258, 397
Peters, Frank, gas well 320
Peterson Mine (see Joubert Placer Mines).
  Placer Mine 482
Petroleum, 1924 production of 399–401
  in Humboldt County 321
  in Merced County 182
  in Monterey County 50
  in Orange County 68
  in Sacramento County 10
  in San Diego County 380
  in San Joaquin County 195
  in San Luis Obispo County 528
  in Santa Barbara County 561
  in Stanislaus County 214
  in Ventura County 242
  proved oil land 401
Phelan Ranch deposits 523
Phosphates in Ventura County 242
Pick & Shovel Mine 508
Pilot Knob & Kearsarge claims 456
    Mine 455
Pine Grove Placer 482
Pine Mountain group 508, 534
  Nut Mine 279
Pinkham's Santa Barbara Mineral Springs 555
Pismo Heights Company's deposit 513
Placer County, ancient channels of the Duncan Canyon region 275–280
  mines (see also under Gold).
    in Calaveras County 161
    in Siskiyou County 461
Plaskett Mine 41

Page
Platinum metals, 1924 production of 263
  in Calaveras County 163
  in Del Norte County 293
  in Humboldt County 321
  in Merced County 181
  in Sacramento County 22
  in San Joaquin County 191
  in San Luis Obispo County 528
  in Santa Barbara County 541–542
  in Siskiyou County 494
  in Stanislaus County 206
  in Ventura County 232
    (see also black sand).
Point Sal deposit 552
Poker Flat dredger 491
Polar Star Mine 534
Pond Water Mine 482
Porphyry Dike Mine 456
Port Arthur claim and Prince property (see Tollgate Mine).
Porter Ranch manganese deposit 319
Porters Bar Dredging Company 491
Portuguese Mine 482
Positions wanted, list of 133, 274, 411, 595
Potash, 1924 production of 264
Potrero silica deposit 376
Pottery clay (see Clay).
Pratt Building Material Company 19, 55
Prattco Sand Pit No. 4 55
Pratt Rock and Gravel Company 20
Preston iron property 318
  W. A., clay deposit 302
    manganese deposit 319
Prince property (see Tollgate Mine).
Prodical Son copper claim 511
Producers and consumers 132, 273, 410, 594
Progressive Placer Mine 489
Prospect Hill Mine 456
Proved oil land in 1924 401
Providence Mine 456
Publications received, list of 126–131, 267–272, 404–409, 589–593
Pumice, 1924 production of 582
  in Siskiyou County 495
Punta Gorda Mine 233
Pyrites, 1924 production of 264

Quartz Gulch Placer 483
  Hill Mine 456, 483
  , industrial:
    in Calaveras County 170
    in San Diego County 374
    in Stanislaus County 216
  Mines (see Gold).
Queen Bee Mine 514
Quicksilver, 1924 production of 264
  in Del Norte County 293
  in Humboldt County 302
  in Merced County 182
  in Monterey County 50–53
  in Orange County 62
  in San Luis Obispo County 529–535
  in Santa Barbara County 542
  in Siskiyou County 495
  in Stanislaus County 215

Rainbow copper group 305
  Mine 456
Ramona molybdenum deposits 351
Ramus, Joe, Placer 469
Ranch Mine (see Sherman Ranch Mine).
Ranchita Mine 346
Rancho Piedra Blanca 508
  Santa Manuela 508
  Santa Rita 510

Page
Raymond, R. W., cited 147
Ready Relief and North Hubbard Mines 346
Red Cap Mine 305, 308
        Quartz and Placer Mining Company 308
    Hill Mine 456, 479
    Mountain Magnesite Company (see California Magnesite Company).
    Porphyry Mine 315
    Rock group of claims 231
        Quicksilver Mining Company (see Acachuma Mine).
    Star prospect 280
    Top Mine, Inc. 157
        prospect 157
Reeder group 456
Reeves Ranch Placer 484
Refineries Clay Company 546
Refugio copper claim 511
Regulation of dealers in gold–silver ores and bullion, act providing for 392–396
Reichman Mercantile Company 450, 469
Reynolds Creek Mine 477
Rhoden, D. F., ocher deposit 168
Riccioli manganese property 524
Ricketts, A. H. 77
Riewerts deposit 36
Riley Ranch deposit 28
Rinconada Mine 534
Rincon Mine 233
Rindge, F. H., property 157
Riverbank Sand Company's property 197
River Rock Gravel Company 198
Riverside brick yard (see Sacramento Brick Company).
    County, Oil field development in 75, 388, 566
Roanoke Mining Company (see Lamphear Mine).
Robertson Mine (see Barnum Bros. Quartz Mine).
    & Carpenter Mine 466
Robinson Gulch prospect 456
    prospect 279
Rock, crushed (see Stone, miscellaneous).
    crystal in Calaveras County 170
    & gravel industry:
        in Calaveras County 169
        in Del Norte County 294
        in Humboldt County 321
        in Merced County 182
        in Monterey County 53
        in Orange County 69
        in San Diego County 377
        in San Joaquin County 196
        in Stanislaus County 217
        in Ventura County 244
Rocky Point Mine 315, 484
Rollin Mining Company 458
Ronning quartz prospect 457
Rosalina Placer Mine 315
Ross & Mann Drift Mine 477
Rossi granite quarry 367
Rough & Ready Placer Mine 317
Roxbury Placer Mine 484
Royal Consolidated Mines 157
    Mine 373
Ruby Basin Mine 447
    Placer Mine 41
Rulon Placer 484
Russ chrome deposit 510
Russell Borate Mining Company 235
    Mine 235, 485
Russian Hill Placer Mine 485
Rycroft Placer 485

Page

- Sacramento Brick Company 9
  - Clay Products Company (See Cannon and Company's pottery).
  - County 1
    - bibliography 22
    - geography and topography 1
    - mineral production, table of 4
    - mineral resources of 2–22
  - Field Division 1–22, 135–172 275–280, 413–498
  - Gas Company 11
  - Mortar and Sand Company 21
  - Sand Company (see Capitol Sand and Gravel Company).
- Safety Chrome Mine 508
- Sale of gold–silver ores and bullion, Act regulating 392–396
- Salmon River district 419
- Salsipuedes Ranch deposit 552
- Salstrom Placer Mine 317
- Salt Cake (see Sodium Sulphate).
- Salt, 1924 production of 583
  - in Monterey County 53
- Salt Lake–California Mine 288
- San Benito County, Oil field development in 75, 249, 566
- San Bernardino County, Oil field development in 75, 249, 388, 567
  - Creek deposit 510
- Sanborn, Frank L. 124, 266, 402, 588
- San Carpajano Creek deposit 510
- Sand:
  - in Calaveras County 169
  - in Merced County 182
  - in Monterey County 54–56
  - in Orange County 71
  - in San Diego County 374, 377
  - in San Joaquin County 196
  - in San Luis Obispo County 535
  - in Stanislaus County 217
  - in Ventura County 244
  - and gravel, 1924 production of 585
  - , foundry, California 251–255
  - , molding:
    - in Sacramento County 21
    - in Ventura County 241
- Sand, refractory 22
- Sandall property 41
- San Diego Brick and Tile Company 356
  - County:
    - description 325
    - geology 326, 332
    - metals in 329–353
    - mineral production, table of 328
    - mineral resources 327–382
    - nonmetals in 353–382
    - oil field development in 75
    - physiography 326
    - Water Company (see Bernardo Granite Quarries).
  - property, lepidolite in 373
- Sandstone, 1924 production of 583
  - in Calaveras County 171
  - in Santa Barbara County 561
  - in Siskiyou County 497
  - in Ventura County 242
  - ornamental, in Siskiyou County 493
- Sanford & Edmundson claim 485
- San Francisco Field Division 23–57, 173–222, 281–324, 499–538
- Sanger Peak copper 288
- San Jacinto Mining and Milling Company (See Daly copper mine).
- San Joaquin Brick Company 188
  - County 184–200
    - geography and geology 184
    - mineral production, table of 186
    - mineral resources 184
    - oil field development in 388

Page

- San Jose Valley Mine 534
- San Luis Brick Company 505
    - Works 505
  - Hot Springs 526
  - Obispo County:
    - geography 499
    - geology 500
    - mineral resources of 500–538
    - oil field development in 75, 249, 388, 567
    - topography 499
- San Marcus Cold Springs 556
- San Mateo County, Oil field development in 75, 249, 388
- San Miguelito Canyon deposit 553
- Santa Ana Mines 59
  - Mining Company 59
  - Rock and Gravel Company 70
- Santa Barbara Builders Supply Company 547
  - Canyon deposit 552
  - County:
    - climate 539
    - mineral production, table of 541
    - mineral resources of 539–562
    - oil field development in 75, 250, 388, 567
    - streams and water shipping 539
    - topography 539
    - transportation 540
  - Mineral Water Company (see Bythenia Springs).
- Santa Clara Mine 534
- Santa Cruz County, Oil filed developments in 388
  - Mine 531
- Santa Fe gravel pit (see Riverbank Sand Company's property).
- Santa Lucia Mining Corporation (see Rinconada Mine).
- Santa Maria Mine 533
- Santa Monica claim (see Capitola Mine).
- Santa Susana Quarry 243
- Santa Ynez River region, oil shale deposits in 561
- Santa Ysabel Springs 527
- Santiago Coal Mine 67
- San Vicente Grant copper deposits 330
    - gold deposits 333
    - silica deposits 376
- Satellite Copper Mine, barite in 164
- Saticoy Rock Company 244
- Sauerkraut Placer Mine 485
- Savoy, Dave, Placer Mine 291
- Scheelite (see tungsten).
- Schley group 348
- Schneider and McCles claim 511
- Schofield Copper Mine 288
- Schon & Blaylock Placer 465
- Schroeder Mine 457
- Schuler Mine 485
- Scioc Mine 457
- Scott Bar & Golden Rule claims 474
  - River region, Siskiyou County 416
  - , Tom, Mine 349
- Senate Bill No. 137 392–396
- Serrano manganese deposit 524
- Service Bros. gravel pit 222
- Sespe Canyon brownstone quarry 244
- Severtson, Hans, gravel plant 380
- Seyer Graphite Mine 369
- Shadows Creek Placer Mine 485
- Shale oil (see Oil Shale).
- Shasta Mine 453
  - Springs 493
  - View asbestos prospect 421
- Sheep Ranch Mine 158
- Sherman Ranch Mine 159
- Shumway Mine 485
- Sickler Gem Mine 363
- Sierra Morena Mine 531
- Sightman Placer Mine 466

Page

- Silica, 1924 production of 583
  - in San Diego County 374
  - in Stanislaus County 216
- Silver, 1924 production of 401
  - in Humboldt County 321
  - in Merced County 181
  - in Monterey County 56
  - in Orange County 62–64
  - in San Diego County 352
  - in San Joaquin County 191
  - in Stanislaus County 206
  - King Mine 348
  - Swan Mine 511
- Simpson-Pirnie Granite Company 366, 367
- Siskiyou Coal and Coke Company 426
  - County:
    - bibliography of 498
    - geography 414
    - geology and mineral resources 415
      - Elliott Creek district 420
      - Klamath River district 418
      - North Central region 416
      - Salmon River district 419
      - Scott River region 416
    - mineral production, table of 422
    - mineral resources of 414–498
  - Dredging Company 491
  - Gold Mines Company 457
  - Mines Company 486
  - River Bend Mine 487
  - Syndicate (see Cub Bear and Blue Jeans prospects).
- Six-Mile Creek Placer 487
- Sky Scraper copper claim 512
- Slab Ranch property 161
- Slate, in Calaveras County 171
- Slate's Hot Springs 47
- Slide Creek Mine 464
- Slim Jim Quartz Mine 457
- Sluice and riffle construction, Peacock Mining Company 316
- Snowball Placer 487
- Snowflake and Little Gem quartz claims 457
- Snow group 543
- Soapstone 1924 production of 265
  - in Calaveras County 171
  - in Siskiyou County 497
- Soda, 1924 production of 265
  - Lake 535
  - niter, in Merced County 182
- Sodium sulphate, in San Luis Obispo County 535
- Southern California Mining and Smelting Company 330
  - Pacific Company 457
    - Quarry 537
- South Mountain deposit 238, 239, 241
- Spanish Bar Mine 317
- Sparks & McClelland sand plant 71
- Special articles:
  - California foundry sands 251–255
  - Dealers in gold-silver ores and bullion must take out licenses 390–396
  - Directory of California Foundries 568–572
  - Mining Law 77–121
- Sponge-iron, by Wakama Iron and Steel Company's process 515–518
- Springs (see Mineral Springs).
- Squaw Gulch Placer 487
- S. R. Crary Mine 487
- Stanislaus County 200–222
  - geography and geology 200
  - mineral production, table of 202
  - mineral resources 201
  - Gravel pit 222
- Stanusich Ranch manganese deposit 524
- Statistics:
  - of 1924 mineral production 123–124, 259–265, 398–402, 574–587
    - by counties 577
    - by substances 576
    - by years 578

Page
Steel plate riffles, used by Peacock Mining Company 316
  production by direct reduction process 515–518
Steele Quarry 498
Stenshaw Mine 487
Stewart Mine 374
Still Ranch property 515
Stockdale granite quarry 368
Stockton Brick and Tile Company 188
  Fire Brick Company 189
  Mineral Products Company 200
Stone Canyon Coal Mine 30
  , miscellaneous:
    1924 production of 584–587
    in Calaveras County 169
    in Del Norte County 294
    in Humboldt County 321
    in Merced County 182
    in Monterey County 53, 56
    in Orange County 69
    in San Diego County 377
    in San Joaquin County 196
    in San Luis Obispo County 535, 536
    in Santa Barbara County 562
    in Siskiyou County 497
    in Stanislaus County 217
    in Ventura County 244
Stonewall Mine 348
Strait, M. E., Ranch 16
Structural minerals, in Calaveras County 163–172
  stone, in Monterey County 56
Sugar Hill Mine 488
Sulphur Spring on Mission Creek 47
    on Tassajero Creek 527
Sunderland Mine 531
Sunnyside Mine 552
Sunset Plaster and Cement Company 239
  View Mine 535
Sunshine and Alviso claims 507
  group 429
Superior Copper Mine 289
Surprise Gem Mine 363
Swartzbaugh, J. O., sand plant 71
Sweetman silica deposit 376
Sweet Marie Mine 291
Sweetwater Chrome Mine 510
Sycamore Springs 526
Sykes Ranch deposit 552

Table of mineral output in 1924:
  by counties 577
  by substances 576
  by years 578
  of mineral production:
    Calaveras County 138
    Del Norte County 284
    Humboldt County 298
    Merced County 174
    Monterey County 26
    Orange County 60
    Sacramento County 4
    San Diego County 328
    San Joaquin County 186
    San Luis Obispo County 502
    Santa Barbara County 541
    Siskiyou County 422
    Stanislaus County 202
    Ventura County 226
  of tests on California foundry sands 256
Take-a-Chance copper group 512
Talc, 1924 production 265
  in Calaveras County 171
Tartaglia group 531
Tassajara copper claim 511
  Hot Springs 47

Page

- Tassajero group 522
- Taylor, R. C., cited 510
- Telluride group 348
- Templeton sand plant 535
- Ten Eyck Placer Mines, Inc. 488
- Tests on California foundry sands, table of 256
- Thomas Mine 488
- Thompson Bar Mine 317
  - Brick Company 301
- Tile (see also brick and tile).
  - in Humboldt County 301
  - in Merced County 175
  - in Monterey County 57
  - in San Diego County 355
  - in San Joaquin County 188
  - in Ventura County 237
- Tin in San Diego County 353
- Tiptop copper claim 511
- Tollgate Mine 159
- Tom Scott Mine 349
- Toro Canyon Brick and Tile Company 547
- Total mineral production of California by years 577–578
- Tourmaline King Mine 363
  - Queen Mine 363
- Travertine (see onyx).
- Triangle claim 432
- Triple Lode Gold Mines, Inc. 160
- Tucker, W. Burling 58, 223, 325, 539
  - cited 147
- Tulare County, Oil field development in 75, 388, 567
- Tullock Mine 160
- Tungsten, 1924 production of 265
  - in San Diego County 353
- Turner & Lloyd prospect 164
- Two and a Half Mine 489

- Uncle Sam Consolidated Quartz Mine 458
- Union Brick Company 357
  - copper group 289
  - Mine 458
- United States Borax Company (see Columbus Mine; also Frazier Mine).
- Upper Soda Spring 493
- U. S. Refractories Company (see Incello Company).

- Vallecito Western Mining Company, Inc. 161
- Valley Spring clay pit 167
    - mineral well 168
- Vance copper property 305
- Vancouver Pinnacles Molybdenum Company 50
- Ventura Cement Company deposit 240
  - County 223–245
    - climate 225
    - geology 228
    - mineral production, table of 226
    - mineral resources 228–245
    - oil field development in 76, 250, 388, 567
    - streams 224
    - topography 223
    - transportation 225
    - Lime and Fertilizer Company 240
  - Excavating Company's clay pit 238
  - Rock and Sand Company 245
  - Velvet molding sand deposit 241
- Van Wert Mine 349
- Veronica Springs 556
  - Stone Company 562
- Verruga marble deposit 372
- Vesa Creek Pocket Mine 459
- Victor Bonanza group 179
  - Mine 161
- Victoria group 349
  - quartz prospect 459
- Victory Gold Mines Company (see also Advance Mine) 459
- Virginia Cons. Mine (see Corey Bros. prospect).

Page

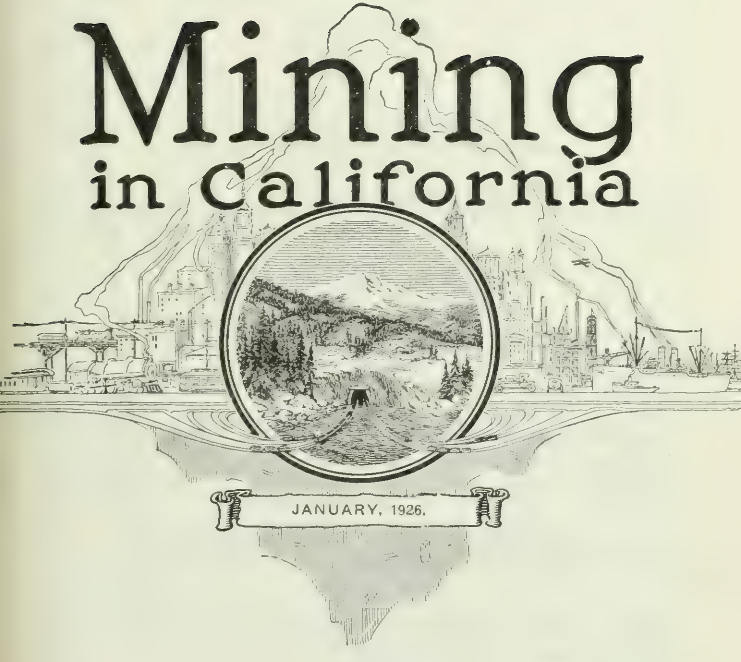
Vitrified Products Corporation 357
Volcanic ash:
  in Humboldt County 324
  in San Luis Obispo County 537
Volk marble deposit 372
Voyle Ocher Mine 214
Vulture Mine 535

Wakama Iron and Steel Company 515
  steel process developed by 515–518
Walker Placer 489
  silica deposit 376
Wanda group 461
Waring, Gerald A., cited 320
Warmcastle Soda Springs 493
Warner's Hot Springs 382
Warren Ranch prospect 535
Washington Mine 160
Weatherby Ranch clay deposit 302
    coal deposit 304
    volcanic ash deposit 324
Webb and Mingus dolomite deposit 36
Webber Construction Company 294
Weeks sandstone quarry 497
Weidman Ranch ocher deposit 214
Weitchpec Bar Mine 317
Welch & Bradley Placer 489
Welsh Ranch deposit 510, 524
Western Pacific gravel pit 200
  States Gas and Electric Company 193
  Stockton glass plant 191
Whistle Bar Placer Mine 489
White Mule group of mines 232
Wilber Womble Mine (see Gold Knoll Mining Company).
Wilcox Mine (see Melrose group).
Willard Drift Mine 474
  Placer 489
Willhite group 329, 349
William Burns Placer 489
  Tell Mine 535
Williams Gold Mining Company 345
  Mine 59
Willow Creek magnesite occurrence 319
Wilson Bros. prospect 461
Wingate Hill Placer 483
Winona group 531
Winship properties 193
Wittenberg Mine 535
W. J. D. prospect 439
Wood gold prospect 461
  , Henry, prospect 429
Woodfill & Barry Placer Mine 489
Wood's manganese prospect 319
Woolsey molybdenite deposit 351
Wurst and Majors limestone deposit 492

Yaeger Mines 62
  Rock Company 70
Yolo County, oil field development in 76
Yosemite Gold Dredging and Mining Company 181
  Portland Cement Corporation 177

Zaar, Frank, Copper Mine 288
Zerfing Ranch deposit 510
Zinc, 1924 production of 402
  in Orange County 62–64
  in San Diego County 353

Mining in California



JANUARY, 1926.

PUBLISHED QUARTERLY

CALIFORNIA STATE
MINING BUREAU
FERRY BUILDING
SAN FRANCISCO

3729

CALIFORNIA STATE MINING BUREAU

EXECUTIVE AND TECHNICAL STAFF

LLOYD L. ROOT
State Mineralogist

WALTER W. BRADLEY
Deputy State Mineralogist

MINING DIVISION

C. A. Logan, District Mining Engineer	Sacramento
C. McK. Laizure, District Mining Engineer	San Francisco
W. Burling Tucker, District Mining Engineer	Los Angeles
Frank Sanborn, Mineral Technologist	San Francisco
W. F. Dietrich, Ceramic Engineer	San Francisco

DEPARTMENT OF PETROLEUM AND GAS

R. D. Bush, State Oil and Gas Supervisor	San Francisco

Note.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations. California Oil Fields.'

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT State Mineralogist

Vol. 22 JANUARY, 1926 No. 1

CHAPTER OF

REPORT XXII OF THE STATE MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1926

CONTENTS.

Page

DISTRICT REPORTS OF MINING ENGINEERS 1

Sacramento Field Division 1

Trinity County 1

San Francisco Field Division 58

Santa Cruz County 58

Los Angeles Field Division 94

Oil Field Development Operations 95

SPECIAL ARTICLES 101

The So-called "Mysterious White Metal" 101

ADMINISTRATION DIVISION 108

DIVISION OF MINERALS AND STATISTICS 109

Statistics 109

Museum 110

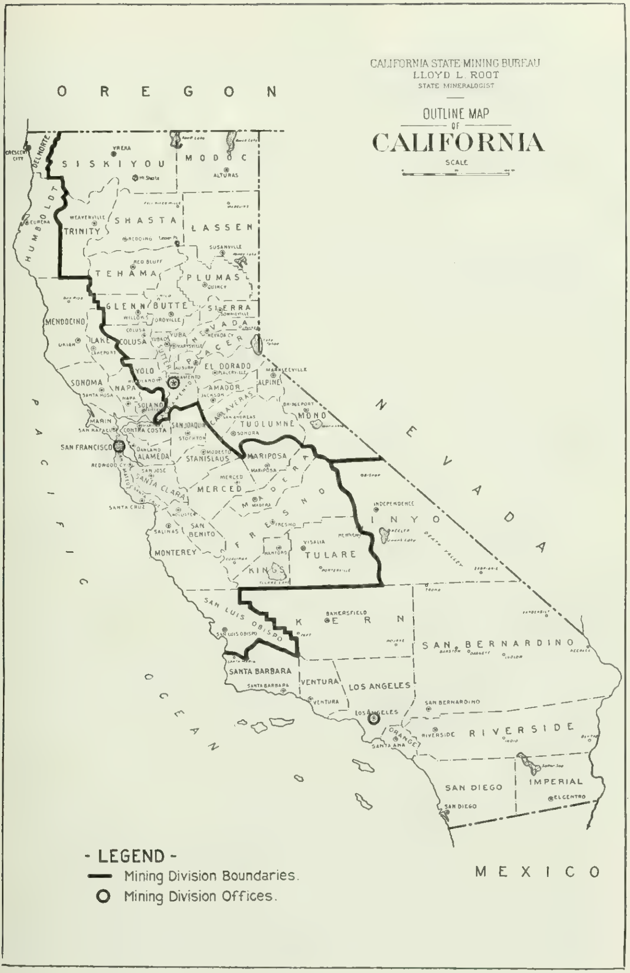
Laboratory 110

LIBRARY 112

PRODUCERS AND CONSUMERS 118

EMPLOYMENT SERVICE 119

BUREAU PUBLICATIONS 1


CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
DEL NORTE
CRESCENT CITY
SISKIYOU
YREKA
MODOC
ALTURAS
HUMBOLDT
EUREKA
TRINITY
WEAVERVILLE
SHASTA
REDDING
LASSEN
SUSANVILLE
TEHAMA
RED BLUFF
PLUMAS
QUINCY
GLENN
WILLOWS
BUTTE
OROVILLE
SIERRA
DOWNIEVILLE
MENDOCINO
UKIAH
LAKE
LAKEPORT
COLUSA
YUBA
MARYSVILLE
NEVADA
NEVADA CY.
SUTTER
PLACER
AUBURN
EL DORADO
PLACERVILLE
MARKLEEVILLE
ALPINE
YOLO
WOODLAND
SACRAMENTO
SONOMA
SANTA ROSA
NAPA
SOLANO
AMADOR
JACKSON
CALAVERAS
SAN ANDREAS
BRIDGEPORT
MONO
MARIN
SAN RAFAEL
CONTRA COSTA
SAN JOAQUIN
STOCKTON
TUOLUMNE
SONORA
SAN FRANCISCO
OAKLAND
ALAMEDA
MODESTO
STANISLAUS
MARIPOSA
REDWOOD CY.
SAN MATEO
SAN JOSE
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
HOLLISTER
SAN BENITO
SALINAS
FRESNO
MONTEREY
HANFORD
KINGS
VISALIA
TULARE
PORTERVILLE
INDEPENDENCE
INYO
DEATH VALLEY
SAN LUIS OBISPO
BAKERSFIELD
KERN
SAN BERNARDINO
BARSTOW
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
SANTA ANA
RIVERSIDE
SAN DIEGO
IMPERIAL
EL CENTRO
- LEGEND -
Mining Division Boundaries.
Mining Division Offices.

PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. Logan, Mining Engineer.

TRINITY COUNTY.

Foreword and Acknowledgment.

Field work for this report was carried on during the summer and autumn of 1925, several trips having been made to different parts of the county. The mining industry of the county has received a good deal of attention in the reports of both the United States Geological Survey and the California State Mining Bureau, during recent years, and because the industry has been very quiet there for the past ten years, it was not found necessary to carry on extended field work. Considerable time was spent, however, visiting placer mines along Trinity

River between Helena and Salyer, quartz mines and placers in the Carrville and Coffee Creek districts, and numerous quartz mines and prospects in other scattered districts. Time was also taken to bring the record of location and ownership of mining property up to date. In spite of the amount of valuable information heretofore printed on the county's mines, most of this is not now available, due to exhaustion of stock of both federal and state publications.

It is also true that even if all these reports were available, they are all fragmentary. It is the plan of the present report to furnish a comprehensive idea of the mineral resources of the entire county. Notes taken by the writer during the past season and in previous field work cover operations not described in other publications, and these other publications have in turn been drawn upon, in cases where there has been little or no recent development. An innovation, and it is hoped an improvement, is introduced by separating purely statistical information, such as ownership, location, and extent of holdings, from the discussion of geology and mine development, putting the former details in separate tables to economize time and space. The characteristics of individual mines are discussed separately, where the properties appear to warrant it, and where operations have been of such an extent as to reveal interesting and informative facts.

The assistance of operators and mine owners throughout the county is acknowledged with pleasure and special thanks are due to Fritz Meckel, Junction City; Harvey Stofer and Charles D. Trask of Helena; J. H. King, French Gulch; B. R. Brown, A. C. Meckel and E. E. Harrigan, Weaverville; John Boddecker and Williams Brothers, Coffee; and J. M. Dikeman, Bonanza King Mine.

Geography.

Trinity County, lying in the northwestern part of the state, embraces nearly the entire drainage basin of Trinity River and its branches, and like Siskiyou County is made up of a succession of mountain chains and deep canyons. This mountain region, known by the general name of the Klamath Mountains, is composed of a number of disconnected chains, lacking the symmetrical arrangement of the Sierra Nevada. These mountains are the connecting links between the Sierra Nevada and Coast Range Mountains. While the Coast Ranges of California are characterized by rounded, gently sloping hills, and broad shallow valleys, the Klamath Mountains are more abrupt in relief. The streams have carved deep, precipitous canyons, except on the upper reaches of the main river, in the northeastern part of the county, and on the Hayfork, where there are comparatively extensive areas of level and arable land. Upon these lands, a little farming is carried on, although the distance to outside markets and the lack of local demand discourages this, and stock raising and mining are the principal industries. Except where the Northwestern Pacific Railroad crosses the extreme southwest corner, there are no railroads within the county, the principal supply point being Redding, in Shasta County, 48 miles from Weaverville, the county seat. Daily mail and passenger stages travel between Redding and Weaverville and other points. The state highway lateral between the two points has not been completed, but is generally in good condition, and greatly facilitates travel. Roads extend from Weaverville to Carrville via Minersville and Trinity Center, and from Redding to these points via French Gulch; also from the state highway at Douglas City to Hayfork and thence to the coast, via Peanut and Bridgeville in Humboldt County. A good highway also extends from Junction City along the river to the westerly county line at Salyer, connecting with the coast system of highways in Humboldt County. Salyer is 40 miles east of Korbel, the nearest railroad point. A toll road runs from Delta to Trinity Center, but has little travel. The mines of the Carrville-Coffee Creek district are 30 to 45 miles from the railroad at Delta or Redding.

The timber and water resources of the county are especially abundant, with many perennial streams. The exception to this is a stretch of 40 miles along the north side of the river, extending from Douglas City downstream. In this region the streams are small and the country dry with a sparse growth of digger pine, but south of the river the streams are stronger and the timber cover better.

The area of Trinity County is 3166 square miles and the population was only 2550 in 1920. The county seat and only town of any size is Weaverville, having about 600 inhabitants and situated at an elevation of 2047 feet in a large area of gold-bearing gravel, but with few active mines at present. Junction City, 12 miles west of Weaverville by road on Trinity River, and Douglas City, on the river and on the state highway lateral [illegible] miles south of Weaverville, were formerly active hydraulic mining camps. Trinity Center and Lewiston are headquarters for the dredging operations on the river. Carrville, Helena and French Gulch (the last named in Shasta County) are the nearest points to the principal quartz prospecting operations.

Hotel accommodations are available at Weaverville, Junction City, Helena, Big Bar, Lewiston, Minersville and Carrville, but at the last named only in summer and fall.

GEOLOGY AND MINERAL RESOURCES.

Summary of Geology of Quartz Mining Districts.

The quartz mines of the county occur in three principal belts. One is on the east side of the county, forming part of a large area of Bragdon (lower Carboniferous) rocks, in which black carbonaceous slate is the most important member. This area extends from Tower House in Shasta County and from near Lewiston in Trinity County, northward to Carrville, and contains numerous formerly productive quartz mines, in both counties. The second area is one of ancient rocks classified as pre-Cambrian metamorphics,[1] occupying a section of country from 12 to 18 miles wide extending in a northwesterly direction from the southern border in the region of Bully Choop Mountain, past Weaverville and as far as the headwaters of the Salmon River in Siskiyou County. Prominent in this area is hornblende schist, varying from fine to coarse grained. This is the wall rock of the veins north of Dedrick. Many varieties of intrusive rocks occur within the older schist. Diorite and granodiorite and various porphyritic rocks are prominent. The granitic rocks occur as large areas, notably on Weaver Bally, in the Thompson Peak region, and west of Helena. Some veins of ore occur in the granodiorite, but the periphery of the granitic intrusive is a more favorable location for prospecting, particularly in case of a large area.

---

[1] Smith, J. P., Cal. State Min. Bur. Bull. 72 and Geologic Map of Cal.

In the northeastern part of the county, and also in the western section, occur a series of rocks grouped by Hershey and others as the greenstone series, and termed by J. P. Smith,[1] "Paleozoic metamorphics, undifferentiated." This series contains slate and slaty schist, altered igneous rocks of various ages, crystalline limestone and large areas of serpentine. A lack of fossils has prevented the exact placing of the various members in the time scale, but the group may contain Devonian, Carboniferous and earlier formations. In the area from Trinity Center northward, and from the western part of Shasta County as far west as Callahan, serpentine is especially prominent. Other rocks of igneous origin which are important because of their connection with ore deposits of the Carrville-Coffee Creek section, are the dikes and larger bodies of granodiorite and granodiorite porphyry (dacite porphyry) and basalt (quartz-augite diorite) and lamprophyre dikes. Mac Donald[2] believed that the granodiorite intrusions occurred in the late Jurassic or earliest Cretaceous, and noticed that at least in places the serpentine dikes (probably originally peridotite) cut the granodiorite, which itself is older than the other igneous rocks mentioned.

In the first mentioned district, in the eastern part of the county in the Bragdon slate area, the gold quartz deposits are in the form of narrow fissure veins usually with slate for one wall and diorite porphyry, soda granite porphyry or some other intrusive dike rock for the other. Quartz is the principal gangue mineral, and pyrite, galena, sphalerite and arsenopyrite occur. The ores of these mines are comparatively high grade with most of the gold of coarse size and only a little sulphide. Many pocket deposits have also been found in this district, nearly all occurring along faulted contacts of the slate and altered andesite. These pocket deposits were studied many years ago by Oscar H. Hershey and described as follows by him:[3]

"At the contact the black rock frequently has a shining luster and a schistose structure due to shearing. This gives it imperfectly the power of a gouge to deflect underground waters. The volcanic rock near the contact has generally been decomposed, softened, and changed to a dull-brown color; it is popularly known as porphyry. In places there is a thin vein of quartz between the so-called porphyry and the black schistose material, but generally they are in actual contact or separated merely by a thin seam of ferruginous dirt. The dirt seam often carries a little free gold, but the pockets are said to be found near or where seams of quartz pentrate the porphyry downward from the contact. The gold lies in a thin, flat sheet upon the igneous rock and under the slate, and in some cases extends a short distance into the former formation, rarely into the latter. It is in the form of coarse and fine grains that have a peculiar smooth and rounded surface quite unlike the free gold in quartz veins.

"The reason that the slate-volcanic rock contact is the great 'pocket' horizon is that it is there that the gold-bearing solution first reaches a carbonaceous rock—the carbon precipitates the gold. The water may reach the contact by traveling nearly horizontally through inclined strata or by ascending under hydrostatic pressure. The sheared slate so frequently found along the contact aids in holding the solution to it while the gold is being deposited. Probably also water issuing from the slate carries the precipitating agent. For a long time the point of union between the precipitant and the gold-bearing water remains at one place or near the contact, and thousands of dollar's worth of gold is thrown down within a space of a few cubic yards or less.''

---

[1] Smith, J. P., op. cit.

[2] Mac Donald, D. F., Bull. U. S. Geol. Survey, No. 530 D.

[3] Hershey, O. H., Origin of Gold Pockets in Northern California. Min. and S. P. Vol. 101, pp. 741–742.

The leading mine of the fissure vein type in this region is the Brown Bear, at Deadwood. It has been developed to a depth of about 800 feet, although geologically similar veins in the same district nearby in Shasta County have proven profitable to much greater depths. The pocket deposits have, as a rule, been exploited only by shallow pits and adits, as the pocket hunter is a grass root miner, averse to deep mining, and not financially able to follow it, although often highly skilled in his particular form of mining. Pocket mining continues to be remunerative to a few miners in this district in both counties, and scarcely a season passes without the report of one or more good-sized pocket discoveries, often running into thousands of dollars. A few mines of this type have been opened by underground workings and have continued to pay over a period of years. The Five Pines is an example.

The mines in the second area, in the pre-Cambrian metamorphics, have varying characteristics. Those in the region of Bully Choop have wide veins, carrying fine gold and considerable sulphide, principally pyrite and copper sulphides and the ores become baser with depth, and are low or medium grade. A little farther north, numerous small mines have been worked where ore has been found rich enough to stand the expense of hauling to the railroad and shipment to a smelter. The ores of these mines in the vicinity of Indian Creek, carry nearly equal weights of gold and silver, and show galena, zincblende, and copper carbonates and sulphides. The veins are generally narrow and developments shallow. On Weaver Bally, some prospects have been opened in the hornblende schist, where the veins occur as small lenses of white quartz frozen to the walls, and carry bunches of high grade free gold ore, with only a small quantity of pyrite. The Fields-Meckel and Patillo prospects, described herein, are in this district. Farther north the Globe Mine in the hornblende schist has been a good producer, yielding high grade ore with finely divided free gold and little sulphide. The geology of these mines is covered elsewhere in this report.

In the Carrville district, the gold lode deposits are of different types. Mac Donald[1] described five types. The characteristics of these will be covered farther on, and it will suffice to say here that the ore deposition in every case appears to have been associated with one or another of the various igneous intrusives, either as a replacement of a dike, or as the result of ore deposition in shear zones, combined with partial replacement of the igneous wall rock, or as fissure fillings in one such rock accompanied by shearing, and small dikes of another intrusive. More active quartz prospecting is going on in this district than elsewhere in the county.

In the district north of Helena some blanket veins near the contact of granodiorite and diorite and with either of these formations for both walls, have paid well. The Enterprise-Lone Jack is the best known and is described. Farther north, a number of veins have been prospected in the region tributary to the East Fork of North Fork of Trinity River, but no production is going on, although several owners are actively working.

---

[1] Mac Donald, D. F., op. cit

The New River district, which at one time had several active mines, is at present nearly deserted by quartz miners.

Summary of Geology of Auriferous Gravel Deposits.

Since none of its streams empty into navigable rivers, all forms of placer mining have prospered without hindrance in Trinity County, and the La Grange mine, the largest hydraulic mine in existence at the time, was operated until the late war, but present operations of this kind are small. In recent years one of the more important gold dredging fields has been developed along Trinity River between Lewiston and Carrville, and this branch of the industry has supplied most of the gold produced since 1918.

The area containing Trinity County's gravel deposits has passed through three separate and lengthy periods of erosion, according to Diller.[1] The earliest of these was the period during which the Klamath peneplain was formed. Hershey[2] believed this was during the Cretaceous. This peneplain was a very important feature, but today only remnants of it are preserved, and can be seen best from some high mountain, from which vantage point it will be noticed that the summits of many of the higher ranges have approximately the same elevation, representing remaining parts of the peneplain, which was reduced nearly or quite to sea level during the Cretaceous. The erosion of the previously formed gold lode deposits, during this and following periods, supplied the gold for the placer deposits, but no important placer gravel deposits have been worked on this peneplain in Trinity County.

The uplift following the formation of the Klamath peneplain was followed by a second cycle of erosion, and the formation of a second peneplain, 500 to 1000 feet lower than the first and corresponding to the Sherwood peneplain, in the neighboring coast counties.[3] Large and important deposits of gravel were formed during the development of the Sherwood peneplain in this county, and these were preserved by being faulted downward into basins where they were protected by rims of harder rock, as shown by the detailed studies of Diller and illustrated by various figures in his paper on Auriferous Gravels of Trinity River Basin,[4] and by the earlier work of Mac Donald.[5] The best example of a mine in the gravel of this age is the La Grange, which has become universally known in recent mining literature because of the magnitude of the former operations. This mine lies at the southwest end of an area of auriferous gravel and glacial till (or 'dead wash') that extended from a short distance southwest of Weaverville to the vicinity of Trinity Center, and had an average width of one to three miles from Weaverville to the East Fork of Stuarts Fork, but which north of there has been eroded by glaciers. This large area is in the so-called Weaverville Basin, where the deposit reaches a thickness perhaps as great as 1000 feet and has been mined for a depth of 650 feet in the La Grange Mine. On the west it is bounded by a distinct fault, easily seen in the La Grange workings, and striking east of northeast there. The stratification planes of the gravel dip toward the fault plane, but the surface of the country slopes east and southeast toward the river. Weaverville has an elevation of 2047 feet, while the summit of the La Grange hill, which has been nearly reached by the mining operations, and shows washed gravel, is at an elevation of 3200 feet. In the immediate region of Weaverville the recent and present streams have eroded and reconcentrated this old high gravel and detrital material, which forms the bedrock for the later accumulations.

---

[1] Diller, J. S., Bulls. U. S. Geological Survey Nos. 196, 470, 540.
[2] Hershey, Oscar H., Am. Geologist. Vol. 25, 1900, p. 86; Vol. 27, p. 245.
[3] Diller, J. S., Bull. U. S. Geol. Survey No. 196.
[4] Diller, J. S., Bull. U. S. Geological Survey, No. 470, pp. 11–29.
[5] Mac Donald, D. F., Bull. U. S. Geological Survey, No. 430.

Other areas of gravel of age and character similar to the La Grange-Weaverville deposits occur on Duttons Creek at the Sweepstakes and Lower Duttons Creek Mines, on Browns Mountain, on Musser Hill, above Trinity River near Lowden, across Indian, Redding and Browns Creeks, southeast of Douglas City, in Hayfork Valley and in Hyampom Valley.

No other mine in gravel of this age has been opened on a scale comparing with the La Grange, although small operations have been carried on in several places. In some cases the gravel is cemented and could not be worked profitably. The cost of water installations on these areas, which are mostly around 3000 feet in elevation, is also an important factor and the water controlled by a few of the larger companies would be needed for their exploitation. The La Grange company's rights could be utilized to the greatest advantage. In general, the gravel of this age is of such low gold content that it can be profitably worked only on a large scale, judging by the average yield in the La Grange operations and in prospecting work carried on by the same company on other areas. The numerous small hydraulic mines worked near Weaverville in years past, (where the Lorenz and Hook & Ladder still continue) have been in deposits formed by the action of recent streams which enriched the gravel while reconcentrating it, making it rich enough to pay handsomely. Lack of grade and dump are factors now and increase the cost of operation by lowering the duty of water, whether it be used for piping up to the boxes and stacking tailing or in hydraulic elevators.

Study of fossil leaves taken from the gravel of this age has resulted in the conclusion that the gravel is of the same age as the earlier gravels of the Sierra Nevada, and the location of the different deposits suggests their deposition by the main Tertiary Trinity River.

The youngest gravels are those forming the bar and bench deposits along the present river and its tributaries. These extended through Quaternary and recent time up to the present. Such deposits occur, where conditions have been favorable, along the entire stream from the tributaries of Coffee Creek in the extreme northeast corner of the county downstream to the mouth of the river, in Humboldt County. The very youngest of these gravels lie in the present bed and lowest bars of the river, and are being worked profitably by several dredgers in the section of the main river between Lowden and Trinity Center. This is free wash gravel, with mostly small to medium sized boulders. Farther upstream on the main river and on Coffee Creek near Carrville, gravel was drilled and reported of good grade. In the latter place a dredger was installed but some of the boulders encountered were too heavy to permit successful operation. There is still considerable unworked gravel along Coffee Creek. The stream has been noted for the production of coarse gold but work along it has been hampered by the size and number of boulders, and in many claims by lack of grade and dump. Pat Holland's Placer Mine, on the East Fork of Coffee Creek has been operated every season for the past 50 years. There are a number of small placer mines which were being worked by one or two men each on the other forks of the creek during the past summer. Some are drift mines in the gravel below the present stream, others hydraulic or ground sluice mines. Near Minersville, the resumption of hydraulic mining has been promised for the present season on the Beaudry Mine.

Going downstream from Lowden on the main river, no activity is noted in the Douglas City district, except at the Union Hill Mine, and only a little work has been done each season in recent years in the Junction City district. The latter district is an interesting one to the geologist, although it has passed its peak in gold production. There has been here a greater development of low bench deposits than anywhere else on the river, and these must have been rich as they have been nearly worked off. The gravel on these benches between the mouth of Dutch Creek and the Jacob Mine is in part distinctly different in origin from the gravel farther upstream. In this section, the wash is characterized by many enormous boulders which have evidently not come downstream in the present river, as they are not seen above Dutch Creek. It is also interesting to note that these mines have produced many nuggets of platinum group metals (principally osmiridium) up to an ounce in weight, but that these metals disappear going upstream above Dutch Creek. No platinum was ever produced at the La Grange Mine. The large boulders may be from fault breccia or landslide material or from glacial debris brought from the north. At Dutch Creek the river changes its general course from southwest and west to nearly north, in line with, but opposite in direction to, the steep course of Canyon Creek, which enters it at Junction City. While no geologic work has been done to trace such a fault, it is possible that Canyon Creek and the northward flowing section of the river may occupy a fault. After passing Canyon Creek the river again turns westward and maintains this direction nearly to the county line where it turns north and receives New River and the South Fork of Trinity River. There is good hydraulic mining ground left near Junction City at the old Jacob claims; also on Canyon Creek, and small acreages at Helena and Big Bar. Between Big Bar and Burnt Ranch the river flows in a steep canyon carved in serpentine most of the distance, and in this section no important bench gravel deposits were formed. Large areas of unworked high bench gravels remain in the vicinity of Hawkins Bar and in the section adjacent to the south fork and main Trinity River near their confluence. In this latter region there is to be seen intact the most complete sequence of terraces anywhere on the river, as described farther on under the Hammer and Kahlke Mine.

On the South Fork near Auto Rest a company has been preparing for hydraulic mining during the past summer. Many claims have been held under placer locations for years along the Hayfork and South Fork but only a little hand work has been done. On New River and its tributaries, Haley[1] noted a number of gravel bars which he considered might be profitably worked. There is little mining of any kind going on in this region west of Big Bar. Most of the properties lack the necessary water supply installations, and many are devoid of equipment, although there appear to be numerous excellent opportunities for developing paying mines. These can not all be described, but descriptions of several properties, representing the different types, are given in considerable detail. Haley's bulletin, cited above, should also be consulted by those interested, for informative notes.

Other Minerals.

In addition to gold, Trinity County contains deposits of asbestos, barytes, chromite, coal, copper, limestone, manganese, marble, mineral paint, mineral water, platinum group metals, quicksilver and building stone. Silver is produced as a by-product, being alloyed with gold. Due to the distance of most of the prospects from railroads, there has been only a limited development of the commercial mineral deposits and gold, silver, copper and platinum group metals have been the principal products. During the world war, many chromite and manganese properties were prospected and some production was made. Except for the prospects in the southwestern corner of the county, near the line of the Northwestern Pacific Railroad, and those in the northeastern section, all these were at long distances from railroads and have remained unproductive.

---

[1] Haley, Charles S., Cal. State Min. Bur. Bull. 92, pp. 92–93.

MINERAL PRODUCTION OF

Year	Gold, value	Silver, value	Quicksilver	
			Flasks	Value
Altoona Mine, before 1875 (est.)*	[6]	[6]	1,000	$88,000
1875	----	----	1,500	126,425
1876	----	----	1,979	87,076
1877	----	----	1,317	49,129
1878	----	----	1,534	50,469
1879	----	----	1,919	57,282
1880	$326,693	$142	245	7,595
1881	550,000	1,500	----	----
1882	600,000	----	----	----
1883	400,000	----	----	----
1884	529,150	[2]334	----	----
1885	338,148	10	----	----
1886	464,726	219	----	----
1887	553,051	924	----	----
1888	589,000	500	----	----
1889	811,632	640	----	----
1890	1,192,790	259	240	12,600
1891	1,327,787	2,249	----	----
1892	1,446,603	168	----	----
1893	1,122,995	----	----	----
1894	1,012,666	325	----	----
1895	1,166,745	1,257	3,926	137,410
1896	1,296,330	----	4,205	139,035
1897	1,078,372	259	838	29,330
1898	859,255	314	4,032	151,200
1899	590,510	1,086	3,076	123,624
1900	571,605	[3]7,935	2,294	105,982
1901	684,683	[3]1,240	1,302	58,668
1902	719,992	550	240	10,251
1903	607,728	2,085	266	11,156
1904	574,814	135	102	3,864
1905	690,844	3,044	389	13,917
1906	560,843	2,981	166	6,059
1907	535,316	2,399	98	3,739
1908	602,944	4,269	90	3,808
1909	520,046	2,302	197	7,915
1910	500,851	1,960	133	5,622
1911	612,149	6,777	44	2,024
1912	723,503	7,494	18	758
1913	431,862	2,119	4	161
1914	743,512	3,374	----	----
1915	441,846	3,470	[4]	----
1916	435,493	7,591	[4]	----
1917	602,048	10,021	[4]	----
1918	444,729	6,912	[4]	----
1919	538,494	3,872	[4]	----
1920	541,387	3,469	[4]	----
1921	437,993	1,390	----	----
1922	182,918	2,432	----	----
1923	617,841	5,816	----	----
1924	422,281	10,934	----	----
Totals	$30,002,175	$114,757	[4]31,154	$1,293,099

*Bradley, W. W., Quicksilver resources of California; Cal. State Min. Bur., Bull. 78, p. 200, 1918.

[1] Includes crushed rock, rubble, sand, gravel.

[2] Lawver, A. M., in 'Production of Precious Metals in U. S.'; Report of Director of Mint, 1884, p. 175, 1885.

[3] Recalculated to 'commercial' from 'coining value' as originally published.

[4] See under 'Unapportioned.'

[5] The metal contained in the 1919 product was 38% iridium and 62% platinum.

[6] No county segregated figures for gold and silver available for years earlier than 1880.

TRINITY COUNTY, 1875-1924.

Platinum		Miscellaneous stone[1] value	Miscellaneous and unapportioned		
Ounces	Value		Amount	Value	Substance
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	3,620 cu. ft.	$5,000	Granite.
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	500 cu. ft.	375	Granite.
----------	----------	----------	5,750 cu. ft.	4,535	Granite.
----------	----------	----------	4,838 lbs. 6,870 cu. ft.	761 5,500	Copper. Granite.
39	$468	----------	----------	----------	
13	200	----------	100 cu. ft.	75	Granite.
11	275	----------	----------	----------	
26	450	----------	----------	----------	
7	130	----------	----------	----------	
[4]	----------	----------	----------	----------	
[4]	----------	----------	----------	----------	
[4]	----------	----------	----------	111,307	Unapportioned, 1900-1909.
[4]	----------	----------	----------	----------	
[4]	----------	----------	----------	----------	
[4]	----------	$2,000	----------	----------	
[4]	----------	1,000	----------	----------	
5	151	----------	----------	245	Mineral water.
13	435	900	120 gals. ----------	360 52,500	Mineral water. Other minerals.
113	5,161	1,000	----------	397,316	Chromite, copper, manganese, mineral water, quicksilver.
50	3,283	7,718	242 tons ----------	6,325 358,447	Chromite. Copper, manganese, mineral water, quicksilver.
41	3,136	1,513	1,814 tons ----------	75,660 175,574	Chromite. Copper, mineral water, quicksilver.
[4] [5]	----------	11,839	----------	17,444	Copper, mineral water, platinum, quicksilver.
fine ounces					
37	6,612	8,799	----------	1,838	Other minerals.
27	3,260	[4]	----------	14,239	Quicksilver, miscellaneous stone.
12	1,223	5,677	----------	5,687	
18	2,050	3,000	329,706 lbs.	48,467	Copper.
11	1,839	2.240	550,000 lbs.	72,050	Copper.
[4]423	$28,673	[4]$45,686	----------	$1,358,705	

ASBESTOS.

Chrysotile asbestos might reasonably be expected to occur in some of the numerous areas of serpentine in the county, and has been noted in several places, but little has been done to exploit these occurrences in recent years. About 12 years ago a company spent some money for equipment and prospecting upon claims near the East Fork of Trinity River in the vicinity of the old Altoona quicksilver mine. This company failed and the claims at present are being held by *Milton J. Brown*, Coffee P. O. Brown has four claims on which are some of the old machinery and buildings and the old sawmill of the defunct company. Castella, 20 miles east by road, is the nearest railroad station.

Rudolph Ott, Shasta P. O., Shasta County, has two claims five miles southwest of the Altoona quicksilver mine, on East Fork of Trinity River, three miles from the Castella road and 24 miles from Castella. He reports that he has not yet found asbestos in place. Asbestos float is found for a distance of five miles from Altoona to Whalen station on the Castella road.

CHROMITE.

Although some of the chromite deposits of the county are remote from the railroad, there was some production during the war from a number of localities.

In the region from Plummer Springs Ranger Station on the northwest to the headwaters of the South Fork of Trinity River and to Tedoc Mountain, there is an extensive occurrence of chert and associated bodies of serpentine. This area is from two to six miles wide, and contains numerous bodies of chromite, the largest of which is that at the Tedoc Mine, in Tehama County. The Trinity County deposits so far opened in this belt were mostly small. The largest producer in the county was the *Crow Creek Group* of claims in Sec. 14, T. 38 N., R. 6 W., on Crow Creek, a branch of the North Fork of East Fork of Trinity River, 18 miles west of Castella. There are numerous other chromite properties in the same region, which is reached by way of the Ramshorn road, running from Castella westward to a point seven miles north of Carrville where it connects with the Carrville-Callahan road. The country rock in this region is principally serpentine, and the district is practically uninhabited except for summer visitors.

Highland Lake Claims produced some high grade chromite, which was hauled to Gibson, 14 miles northeast.

The Integral Chrome Mining Company did some mining on the extensive holdings of *Integral Quicksilver Mining Company*, which has over 2600 acres of land in Secs. 14, 15, 21, 22, 23 and 27, T. 38 N., R. 6 W., adjoining the Crow Creek Group on the south and 21 miles from Castella.

Mumbo Creek Group is in Sec. 4 or 11, T. 38 N., R. 6 W., one to two miles north of the Crow Creek Group.

Picayune Lake Group of 14 claims is still farther north, in Secs. 23, 26 and 27, T. 39 N., R. 6 W., and the nearest railroad station is Gibson, 16 miles northeast by trail and road.

Other claims, some of which produced small tonnages of chromite, were worked in the vicinities of Wildwood and Peanut. These were a long way from the railroad, some as much as 75 miles. They have long since been abandoned.

Bibl: Cal. State Min. Bur. Bull. 76, pp. 209–212.

COAL.

Lignite occurs at numerous places in the county but has been used only locally for blacksmithing and domestic purposes. Probably all these occurrences were formed in Tertiary lakes or basins, such as the Weaverville basin or the smaller one at Big Bar. All the known occurrences are long distances from the railroad.

Big Bar Prospect. W. A. Pattison, Big Bar, owns hydraulic mines, now mostly worked out, one-half mile west of Big Bar post office on the south side of Trinity River, where lignite occurs as part of the strata underlying the bench gravel. Hydraulic mining has exposed the coal and a little of it has been used locally for blacksmith work.

The coal is exposed in a gulch for a distance of 250 feet, striking north and dipping west. It is evident that when the river flowed on this bench, the coal and associated shale and conglomerate formed a peninsula, surrounded except on the west by water. It is probably part of an ancient lake or marsh, and on the west the strata may extend a considerable distance under the old diggings, forming a basin of which the exposed edges are part of the rim.

The upper three feet of coal is fairly clean and increases to five feet thick where it passes under a gulch. On the west side of this gulch, this layer passes downward on the dip, and the bank above it shows six feet of brown shale with some seams of coal; one foot of coal; 1½ feet of conglomerate; and five feet of mixed coal and sandy shale, with as much as three feet of coal in the widest part.

Some short prospect adits have been run. As the deposit is 77 miles by road from Redding, the nearest railroad point on the east, and nearly as far on the west, and there is only a very small resident population in the district, there appears little chance for profitable development.

In *Hayfork Valley*, in the river one and two miles downstream from Hayfork, two outcrops of lignite were found many years ago, and were described in our past reports, particularly in the Twelfth Report of the State Mineralogist. The coal is described as a black, tough lignite of good quality, and three separate layers, five, one and six feet in thickness, respectively, were noted. Numerous other exposures of lignite have been noted in this valley. The lignite was deposited in Tertiary, and possibly earlier, time as a part of the filling of an ancient basin of same age as the Weaverville basin. Hayfork is 65 miles by road from the railroad at Redding.

In *Hyampom Valley* where Hayfork Creek enters South Fork of Trinity River, numerous outcrops of lignite have been noted, and described in the above volume. Some of the layers of lignite are eight to ten feet thick, and are said to be of good quality, resembling other lignites found in Amador County and the Mount Diablo region. Only a little prospect work has been done upon these outcrops. Hyampom is nearly 90 miles by present roads from the nearest railroad point.

At *Poison Camp* in Secs. 22 and 15, T. 2 S., R. 6 E., H. M., lignite occurs in a vein three feet thick.

Near *Redding Creek*, seven miles southeast of Douglas City, Diller[1] noted "shaly coal 5 to 15 feet thick" occurs in the lower part of ancient gravel deposits.

Lignite has also been noted in the lower part of the gravel deposit mined at the Union Hill hydraulic mine near Douglas City, and in the bedrock of hydraulic mines in the Weaverville district.

Numerous analyses of Trinity County lignite were published in the Twelfth Report of the State Mineralogist, and indicate from 9% to 14% water, 34% to 47% volatile matter, from 19% to 42% fixed carbon, and a widely varying ash content, due probably to difference in degree of weathering of some samples.

Bibl: Cal. State Min. Bur. R. X, p. 716; XII, pp. 62–64; XIII, p. 56; XIV, p. 877. Bull. U. S. Geol. Survey, No. 470, pp. 21, 22, etc.

COPPER.

Copper prospects are found in areas of peridotite and serpentine and on their contacts with other rocks, in New River district, Carrville and Trinity Center district, adjacent to South Fork of Trinity River between Hyampom and Rattlesnake Creek, and in the extreme southwestern corner of the county, where geologic conditions are different and where the only important producer has been developed. All of these districts except the last named are so far from the railroad that little has been done with the prospects. It costs so much to haul ore to the railroad that only a very rich ore or concentrate would yield any profit. Hauling from either the New River or South Fork districts would be out of the question at present prices for copper. This leaves only the Carrville-Trinity Center district and Island Mountain district of possible interest at this time. No active mining or prospecting of copper properties was going on in the Carrville region during 1925. For information regarding old properties, the reader should consult the references cited under bibliography. No new field work was done in this connection.

Island Mountain Consolidated Copper Mine. Owner, Island Mountain Copper Co., care E. R. Leach, 210 Hillside Ave., Piedmont, California. Frank A. Leach, president, 710 Easton Building, Oakland. This property is in Secs. 9, 10 and 15, T. 5 S., R. 6 E., close to the line of the Northwestern Pacific Railroad. It has been the principal producer of copper in the county. From 1892, when it was discovered, until the completion of the Northwestern Pacific, prospecting and development were carried on. Since then ore has been shipped to the Tacoma smelter, and at times a maximum of 1000 tons of ore a month was produced. It is claimed that 275,000 tons of ore was proven, of which a small part has been shipped.

The ore contains copper and iron sulphides, and some gold, silver and zinc. It is said to average 3½% copper, 1½ ounces silver and up to two dollars a ton gold. The outcrop has been traced 800 feet on the strike and has a maximum width of 130 feet. The claims extend diagonally across Lake Mountain, around which Eel River makes a horseshoe bend. The old lower tunnel is 400 feet below the highest outcrops. The hanging wall is soft sandstone and the footwall shale. The ore body is thought to be 90 feet wide and 450 feet long and has been prospected by several thousand feet of workings.

---

[1] Diller, J. S., Bull. U. S. Geological Survey No. 470.

Other groups of claims in the vicinity of Van Duzen River in the southwestern part of the county are mentioned in Bulletin 50.

Bibl: Cal. State Min. Bur. Bull. 50, pp. 140–150; R. XIV, pp. 878–882. Bull. U. S. Geol. Survey, No. 530 D, pp. 25–26.

GOLD QUARTZ MINES.

The geology of the various quartz mining districts has been covered in the introductory paragraphs of this report, in a general way, and more detailed notes are shown below for a number of mines. No attempt was made to visit all the idle quartz mines and prospects, but a sufficient number of those in each district which had not been adequately described in previous reports, are described in considerable detail so that the reader can obtain an idea of the various types of deposits in all parts of the county. The table of quartz mines and claims gives references to past publications of the State Mining Bureau and U. S. Geological Survey, which are available in this Bureau's offices, and which contain data regarding other properties, nearly all of which are idle at this time.

Quartz mining has been confined for the most part to prospecting during the past ten years in Trinity County, and much of the following is in the nature of history, but it is believed it will be helpful in showing what may be expected in developing properties of the same general types as those described. Very little ore has been milled in the county in recent years, and at times not a single mill has been in operation. Nevertheless, the person who is sufficiently acquainted with the county can not help realizing that many mines as good as those already worked remain undeveloped, because of the remoteness and inaccessibility of parts of the county.

The timber, water resources and possibilities for cheap mining are excellent. In many streams sufficient water is available for generating electric power for operating mining machinery.

Brown Bear Mine has been the largest quartz gold producer in the county, but has been idle, except for small-scale leasing operations, during the past 12 years. It was the principal mine of the Deadwood district, and a total production of $8,000,000 has been claimed for it. This property has been covered in considerable detail in past publications, as will be noted by reference to the bibliography in the table. Mines in this region were not visited for the present report, but the following notes on this property are taken from a description written by H. G. Ferguson[1] in 1912, when the mine was in operation:

"The mine has been opened by crosscut tunnels at depths of 340, 395, 420, 520, 640, 725, and 1080 feet below the outcrop, besides several smaller old workings between the outcrop and the upper level. As two principal veins have been developed to a maximum distance of 1400 feet, besides drifts on minor veins, and the longest crosscut is about 2300 feet, it follows that there are several miles of workings. In the short time available it was impossible to make more than a very hasty examination of a comparatively small part of the mine.

---

[1] Ferguson, H. G., Bull. U. S. Geol. Survey No. 540, pp. 70–71.

"There is a 10-stamp mill with two Wilfley tables, capable of handling about 20 tons a shift. In September, 1912, the force consisted of four miners and seven lessees.

"The country rock is slate of the Bragdon formation, cut by a large number of irregular intrusions that represent different types, including both diorite and soda granite porphyry.

"There is almost everywhere evidence of motion along the slate and porphyry contacts. At only one place was an intrusive contact without gouge seen. The veins lie for the most part in slate but also cut the porphyry. Besides numerous small veins and stringers two principal veins have been worked: these are parallel and have an average strike of N. 80° E. The northern vein, the Monte Cristo, dips steeply to the north: the Last Chance, 200 feet south of the Monte Cristo, dips south at angles between 60° and 80°. The width is as a rule not over two feet, more commonly about six inches, but stopes have been taken out to a width as great as 22 feet. Two small veins developed to some extent on the lower levels have strikes of N. 20° W. and N. 50° W.

"The ore shoots on the Last Chance vein appear to pitch at a rather flat angle to the east. The veins show slipping along both walls and there is always some gouge present, locally as much as three inches. The gouge carries fragments of quartz and a little gold. It is very rare that the ore is frozen to the wall.

"Quartz is the principal gangue mineral. Much of it has a cloudy blue-gray color and in many places it is banded, owing to inclusions of slate parallel to the walls. Calcite is comparatively rare in the ore and is more commonly seen in the small irregular stringers in the slate and porphyry near the veins. Manganese oxide is noticeable in the surface quartz. The sulphides consist of pyrite, galena, sphalerite, and arsenopyrite. The concentrates carry about $100 in gold to the ton but form a very small percentage of the ore. Pyrite is the most common sulphide and is found both in the veins and impregnating the slate and porphyry walls. Small stringers of pyrite cut the slates near the veins, and the joint planes of the slate and porphyry are in places heavily pyritized. Galena and sphalerite show no tendency to migrate into the country rock and are found in the vein, their presence generally indicating rich ore. Although they are rare in the ore as a whole, in a few places the vein is almost entirely made up of these two minerals and pyrite. Arsenopyrite is almost exclusively confined to the altered porphyry where it occurs both in crystals scattered through the rock and in extremely minute crystals along joint planes. Visible gold is common. All the gold seen was in the quartz close to either an included fragment of slate or a patch of galena. Its fineness is about 0.840. The best ore of the present workings runs over $100 a ton and the general run of ore as stoped is between $20 and $50."

Craig (Mason & Thayer) Mine is three miles southeast of Dedrick on the headwaters of East Fork of Canyon Creek at an elevation of 4200 feet. Leased with option to F. A. Hebbard et al. The property is reached by steep road via Junction City, and Redding, the nearest railroad station, is about 70 miles east.

According to Ferguson[1] "the vein is entirely within the hornblende schist, which here strikes N. 55° W. and dips 70°–85° S. * * * As in the Globe mine, the vein is a series of quartz lenses and cuts the schist at almost a right angle. The quartz, however, nowhere entirely pinches out, as in the Globe, but varies from three inches to six feet in width."

The vein has been prospected and ore blocked out by a series of three adits on one side of a gulch, and this gulch may indicate a line of faulting, as adit No. 4, on the other side of it, has been run beyond the point where the vein was expected, without striking it. No. 1 adit is 300 feet long, but caved in front. No. 2 is 67 feet lower and is 440 feet long and is said to be in the widest and best part of the vein, which is reported to have been lost on this level. No. 3 adit is 70 feet below No. 2 and is 740 feet long with a winze 38 feet deep 440 feet from the portal, and vein is said to be split in three parts in this winze. Two raises have been put up from No. 3 to No. 2 adit and the bulk of ore developed is in this block, the ore shoot being about 200 feet long and from 2½ to 7 feet wide, with a horse in the wider part.

Harvey Stofer, formerly superintendent, took 880 samples from all parts of the mine for the Crown Reserve Mining Company several years ago and reports these gave an average value of $7.10 a ton for an average width of about three feet. The property has been idle since 1915, previous to which several operators worked without crushing much ore. A total of 315 tons of sorted ore is said to have averaged $11 a ton free gold. The ore carries considerable pyrite, some in coarse cubes.

In the autumn of 1925, Hebbard was moving a 5-stamp mill to the property and planned to begin milling at an early date. There are several buildings on the claims.

De Cordi Prospect and *Dixie Queen Claim* both in the vicinity of Spring Gulch, three miles from the old camp of Indian Creek and eight miles by road and trail southeast of Douglas City, are typical of the district. The former shows complex ore with some malachite and azurite.

Dixie Queen Claim has produced $5,000 to $6,000 in high grade ore which yielded $100 to $384 a ton. The ore occurs in a vein six inches to one foot wide following a decomposed dike between 'porphyry' walls. Ore is base, containing about equal weights of gold and silver, with considerable galena and zincblende. It required smelter treatment, and the cost of mining, hauling, railroad freight and smelter charges was about $50 a ton. Only assessment work was being done at claims in this region in 1925.

Democrat Group consists of 15 unpatented claims, 243 acres, named Democrat Nos. 1 to 15, 1½ miles from Weaverville on ridge between West Weaver Creek and Democrat Gulch.

What is termed the main vein has been prospected only by a few shallow holes and so far has not shown any ore. It runs northwest. Shallow workings along the west side of a serpentine dike, which strikes S. 77½° E. toward the main vein, have yielded several small bunches of rich gold ore, totaling perhaps $5,000 to $10,000. The pay was found in seams and stringers in the decomposed 'porphyry,' probably a basic intrusive originally, and the largest bunch was followed to a depth of 33 feet in a winze, where it is said to have pinched out.

---

[1] Ferguson, Henry G., Gold Lodes of the Weaverville Quadrangle, California, Bull. U. S. Geol. Survey No. 540, p. 78.

A lower adit enters from Democrat Gulch at an elevation of 2350 feet (aneroid) and runs N. 60° E. through decomposed porphyry for 215 feet, where it crosses the serpentine dike 73 feet wide, and thence to the face for a distance of 75 feet is in black graphitic schist carrying quartz stringers. This quartz-bearing formation is straightening up near the face, with an easterly dip and strike northwest. It carries arsenopyrite up to eight per cent, but so far little gold.

Dorleska Mine adjoins the Yellow Rose Mine on the divide between the headwaters of Coffee Creek and South Fork of Salmon River at an elevation of 6500 to 7000 feet, and 16 miles by trail from Coffee or Trinity Center.

The geology of the deposit is similar to that of the Yellow Rose (which see), the two properties being on the same vein, which occurs in a fault zone at the contact of a lamprophyre dike and serpentine.

The mine was discovered shortly after the finding of the Yellow Rose, and the early history of the two was similar. The Dorleska was later equipped with a 5-stamp mill and subsequently five stamps more and a Huntington mill were added. The total production of the Dorleska is estimated to have been about $200,000.

This mine was developed by a shaft 350 feet deep with three levels, and a winze 50 feet deep from the lowest of these is said to be in ore. Drifts are said to extend about 150 feet north and south in the soft, oxidized ore. The mine workings made considerable water, which presumably had a good deal to do with closing. A tunnel from the Salmon River side would give drainage. The property has been idle many years.

There are numerous other prospects and small mines in the vicinity showing little activity except annual assessment work.

Enterprise Mine. Lessees with option, Chas. D. Trask, Frank R. Brown, W. R. Beall, and H. D. Stirm. Mine address, Helena P. O. It is six miles by road north of Helena. Holdings are Enterprise No. 1 and No. 2, Cleve, Bo, Sunny, Hendy, Lonely Jack, Black Bone and Oak.

The outcrop of the Enterprise vein near the discovery point, according to Fritz Meckel, was partly in granodiorite and partly in diorite, and the vein was not displaced at the contact. The North Star workings, in the granodiorite, were not in as good ore as in the diorite. The property has been worked since 1884 and is said to have produced about $500,000.

The Enterprise blanket vein dips 17° to 19½° west between diorite walls (on these claims). Several step faults move the vein from two to 15 feet with the quartz continuous through the breaks. The vein varies in width from six inches to six feet, and has little or no gouge. A prominent fault striking S. 60° E. and dipping about 47° N. cuts across the vein near the west faces of the Lonely Jack workings.

The most extensive workings have been upon the Lonely Jack claim, where the main adit was driven west and northwest for 1300 feet in the blanket vein. A large area of ground has been stoped out from this level. Near the back of level, four winzes go down from a central point on an incline of 20° to 25°, being 160 feet deep on the incline or 52 feet deep vertically. These winzes and the lower workings are inaccessible, and maps of the workings have been stolen, but Fritz Meckel, a former lessee, states that 100 tons from the winze workings yielded $6,500 and that a width of six feet of ore on the intermediate level (below the main adit) carried from $7 to $18 a ton in gold. Meckel and Skinner produced and milled 3000 tons of ore which yielded $110,000. No ore yielding less than $7 a ton could be worked at a profit. The pay was spotted and capriciously distributed, and a great deal of good looking but probably low grade quartz remains.

Outside the Lonely Jack workings on the same side of the canyon near the mill, other bodies of quartz parallel to the main vein have been shown by prospecting. Late in 1925 one such vein was uncovered by Mr. Trask who used a hydraulic monitor to wash off the soil overburden. This recalled the early placer operations in the creek, where the finding of gold in quartz led to the finding of quartz veins. The deposit appears to be a series of parallel blanket veins, with numerous quartz filled joint planes between, a condition promoted by the blocky nature of the country rock; but at this date little could be learned as to the distribution of the gold, although pay is said to have been better where the vein flattened.

The Enterprise claim on the opposite side of the creek has not been so extensively developed as the Lonely Jack but is stated to have yielded about $100,000.

Water under 110 feet fall is taken from the East Fork of North Fork of Trinity River through 5400 feet of ditch, 1100 feet of pipe line and 2500 feet of flume two by three feet, and is used for generating electricity and operating the water-power mill. The mill contains 10 stamps of which five are in good shape, and there are a compressor and several good buildings. Active work was planned for the winter of 1925–26.

Fields-Meckel Prospect comprises seven unpatented 20-acre quartz claims called Klondyke, General Lee, Lone Star and Mt. Bally Nos. 1 to 4, on unsurveyed land on the south slope of Weaver Bally, at an elevation of about 6000 feet, 12 miles from Weaverville and reached only by trail. A millsite about a mile south and 1000 feet lower is also claimed.

The lowest adit is at 5810 feet elevation and follows the vein N. 75° E. for a distance of 230 feet. The vein is from six inches to two feet wide and forms small lenses of solid white quartz, the longest of which is 35 feet long. There is a raise 32 feet above the adit. The vein is tightly frozen to both walls, which are hard hornblende schist. The best showing so far on the property was at the portal of this adit, where $2,500 is said to have been extracted from a hole two feet deep on the vein. The vein shows six inches of quartz at the face, and is said to pan well in fine free gold as far as drifted. It shows free gold in places. There are three other adits, the lowest, now caved, being 50 feet below the one described, and two short ones recently started 100 feet and 150 feet above the main adit. All these are in an area of a few acres and the rest of the claims are unprospected except for shallow pits, although the vein is said to be traceable for 2000 feet.

Assessment work only is being done and there is no equipment except hand tools.

Five Pines Mine has been active at intervals during late years and during 1925 has been under lease and option to James Skeen and partners. It is on the road between French Gulch and Trinity Center, two miles east of Trinity River. Skeen has been unwatering and prospecting the property. The geology has been covered in reports mentioned in the bibliography.

Globe Consolidated (*Globe, Chloride and Bailey*) *Mine* lies four miles north of Dedrick, at an elevation of 6100–6700 feet, near the top of a mountain between Canyon Creek and Stuarts Fork.

The mines included in this group were discovered in 1889 and the first recorded production made in 1891, when 1113 tons from the Chloride group produced $22,000; small runs from the Bailey averaged $12 and $40 a ton, and 30 tons from the Globe group averaged $30 a ton. The Chloride and Globe groups at the time each had a 3½-foot Huntington mill.

The Globe vein (and other undeveloped veins parallel to it) consists of shattered white quartz in a series of lenses. At the point of Joe Van Zeile's discovery, it was 3½ feet wide, but varies in width from 18 inches to 36 feet and was mined for a width of 9 or 10 feet in several places. Both walls are hornblende schist. According to H. G. Ferguson[1] the gold in the vein is so finely divided as to be invisible to the eye, and "the best ore is generally found along the hangingwall." Spots and stains of manganese oxide are considered as favorable indications. The vein occupies a shear zone nearly at right angles to the schistosity of the wall rock.

The vein has been explored and mined through a system of adits of which the principal ones worked in later years are Union adit, 500 feet long and 500 feet below the apex; No. 1 adit, 75 feet below Union; No. 2, the main working adit, 202 feet below Union adit, and 1700 feet long, extending entirely through the mountain from the Stuarts Fork side to the Canyon Creek side; and No. 3 adit, 149 feet below No. 2, giving a maximum depth of about 850 feet explored, and a maximum length of 1700 feet on the strike. The intervals between lenses of quartz were generally not over 20 feet for this entire distance, and the quartz lenses averaged about 200 feet long. In the Union workings an ore body 60 to 80 feet long in the form of a lens with a maximum width of nine feet was worked. Apparently the same ore shoot was proven from the bottom of No. 15 shaft (149 feet below No. 2 adit and 700 southwest of the face of No. 3 adit). Ore was stoped from below No. 2 level to a point 140 feet above Union level; on an easterly shoot from No. 2 level to above Union level, and at an earlier date from No. 3 to No. 2 level. No. 8 shaft and No. 15 shaft were each sunk about 149 feet below No. 2 level, and are 700 feet apart. The block of ground between these shafts has been only partially explored and is said to show 18 inches to two feet of ore that will assay $25 to $40 a ton, as far as opened. After the last company ceased work, Harvey Stofer obtained a lease on a block of ground above the Union level and mined good ore, but worked under difficulties on account of the number of times the ore had to be handled.

---

[1] Ferguson, Henry G., op. cit., p. 77.

After the early period of activity, large operations began under Globe Consolidated Mining Company in 1910, and an expensive and complete plant, said to have cost $150,000, was finished late in 1913. It included a 20-stamp mill, a cyanide plant of 100 tons daily capacity, an automatic tramway 5600 feet long, and numerous buildings. The mill was two miles from the mine, on Canyon Creek. This company continued work until late in 1918, and are said to have produced about $300,000. In 1919 the mine was sold to Metals Exploration Company, who spent more than a year in exploration and preparation for milling, but made only short test runs. The Bailey tunnel, which entered the old Bailey claims below and to the southwest of the Globe workings, and No. 6 adit entering from the Canyon Creek side at the same level, would have given 600 feet more of backs below No. 3 level. This No. 6 level was continued a long distance in the direction of the Globe vein, but it is said results were disappointing. The company ceased work in 1920 and most of the machinery was removed. Old equipment for 10 stamps remains on the Stuarts Fork side. Water for power was taken from Canyon Creek through 6800 feet of flume and 2500 feet of 24-inch pipe.

Golden Jubilee Mine. D. C. and L. G. Williams, Coffee P. O., have a lease and option to purchase. It comprises 10 unpatented claims, covering 4500 feet along the strike, one mile south of Coffee P. O. at an elevation of 3000 feet.

The mine was discovered in 1892 and was operated until 1900, then lay idle until 1905. The old reduction plant contained two Huntington mills and a small cyanide plant. In 1908 a new mill of 10 light stamps and 30-ton cyanide plant was built but the property operated only a year or less, then lay idle until 1915. The last work previous to present operation was in 1916 by the California Extraction Co. The total production is claimed to have been 22,500 tons, which yielded $150,000. Most of the gold realized came from 'high grade' ore which was shipped to a smelter.

The vein is a fissure filling in granodiorite about two miles south of a body of gabbro, and small lamprophyre dikes have been noticed in several places in the mine either in contact with or near the vein on the footwall side. The walls and vein are crushed by post-mineral shearing, but some of the branching quartz stringers, as in the lowest level, where they carry high grade ore, are frozen tightly to the walls, although even at this depth, 700 feet below the outcrop, the fissure shows a good sized gouge and considerable water. The vein strikes N. 30° E. to N. 20° W. and dips 80° E.

The vein has been developed by seven adits entering the steep mountain slope at elevations ranging from 3050 feet to 3700 feet, the deepest (No. 5) giving 700 feet of backs and having a length of 1400 feet in October, 1925. The present work is in No. 5 adit, which has been advanced 215 feet by the present lessees. Near the face they have lately sunk a winze (30 feet deep last October) where they encountered a narrow vein of high grade ore, showing free gold and telluride ore.

The vein pinches and swells and this work is in a narrow place. Beginning with the uppermost, the other levels are:

B	Elevation 3700 feet	Length 400 feet	(caved)
A	Elevation 3600 feet	Length 440 feet	
No. 1	Elevation 3500 feet	Length 440 feet	
No. 2	Elevation 3400 feet	Length 680 feet	
No. 3	Elevation 3350 feet	Length 680 feet	
No. 4	Elevation 3300 feet	Length 700 feet	

The ground between No. 4 and No. 5, over 200 feet on the dip, has not been explored. The outside ore shoot was stoped for a length of 300 feet and it varied in width from 18 inches to 10 feet between No. 3 and No. 1. In places the ore was oxidized to a depth of 300 to 400 feet but even between B and No. 1 levels assays indicated most of the gold in the sulphides. The middle ore shoot, about 80 feet long, was stoped from No. 3 to A level. The inside shoot, 110 feet long, is the one on which most of the estimates of ore reserves are based. The reserves claimed comprise 7157 tons of a total indicated value of $111,000. This is between No. 2 and B levels, and would require a tram to deliver it to the mill, below No. 5 adit, unless a raise should be put through from that level. All the work has been upon the Grizzly claim. Another shoot is thought to exist under the Golden Jubilee claim, where the rich Onion Flat placers were worked up to the vein outcrop. Some extremely rich telluride ore has been taken from the mine in small lots.

Besides the 10-stamp mill, small cyanide plant and old Huntington mill, there is a 9″ by 8″ air compressor, two water motors, 1000 feet of 6-inch and 10-inch iron pipe, three concentrating tables, air drill equipment and several buildings. Water for power and milling is taken from Boulder Creek through one mile of ditch giving 235 feet fall, and the supply is ample.

In the old mill, a recovery of 93 per cent was claimed, using outside amalgamation, cyanide treatment of slimes by agitation and decantation, concentration of the sands and subsequent cyanidation of concentrate and tailing. Only about 20 per cent of the gold was recovered by amalgamation and the balance by cyanidation. There was one per cent of pyrite and galena, in part oxidized.

The *Poeth (Liberty) Wagner and Burner Mines*, all of the same type of deposit as the Golden Jubilee, are nearby on the north. None are active at present, although all have been small producers in the past. The *Dewey*, *Lily of the Valley* and *Sunshine* prospects are also located nearby. All of these mines and prospects are in the same area of granodiorite, which is about four miles long north and south and two to three miles wide. The Golden Jubilee is the most extensively developed property in the district.

Headlight Consolidated Quartz Mine is two miles by trail and road southeast of Carrville on the east side of Trinity River, and 600 feet above it. Sixteen years ago this property was the largest and most promising quartz mine in the district. In 1910 it was equipped with a 40-stamp mill, a cyanide plant of 250 tons capacity, electric power plant, sawmill and numerous buildings. The sulphide ore body was oxidized near the surface and operations were profitable for two years, the ore having been worked by glory hole and drawn off by gravity through tunnels. But at a shallow depth fresh sulphide ore was found, carrying a great deal of pyrite and some copper, not amenable to treatment used on oxidized ore, and the plant was closed and removed. According to Brown[1] the production was $500,000. The ore averaged about six dollars a ton in gold and operating cost was about $2.40 a ton.

The geology of the property was covered in detail by Mac Donald[2] who describes it as "a replacement deposit in a basaltic dike where this dike cuts a larger dike of granodiorite porphyry, in a country rock of andesitic greenstone which is in contact with slate. Though no conclusive evidence of the matter was found, it is thought that the basaltic dikes were planes of weakness which yielded to shearing and thus afforded easy access to the acidic mineralizing solutions from the granite porphyry." This ore body was gossan capped, lay quite flat and covered over two acres, with thickness varying from 25 to 72 feet, averaging 40 feet. The soil overburden was stripped by hydraulicking.

The company claimed, in 1912, that 300,000 tons of ore remained proved as an ore reserve, of an average value of six dollars a ton. The last plant cost $156,000.

Hidden Treasure Prospect is on the East Branch of East Fork of North Fork of Trinity River, 14 miles north of Helena, the last seven miles being by trail from the end of the road at the old Yellowstone mine.

An adit about 120 feet long has been run northwest from the north bank of the East Branch, following a seam. Fifty feet from the portal, the seam opens into a lens of quartz with a basic dike. The vein has a maximum width of three feet and dips 50° SE. This lens is about 50 feet long. The quartz shows some pyrite. Idle.

John Boddecker Prospect contains three quartz claims just west of Coffee P. O. On the Katherine claim there is an adit 150 feet long of which 75 feet is on the vein. Some good ore was milled from this. On the Josephine claim, an adit was run 75 feet and a winze which was sunk 25 feet is said to show three feet of ore, and some rich ore was taken from this years ago. On the Virginia claim, an adit was driven 50 feet. There are three separate veins and the geology is similar to that of the Golden Jubilee Mine. Only assessment work is being done.

Keating (Hardscrabble) Quartz Mine is on a deposit geologically similar to that mined in the Dorleska and Yellow Rose mines. It is northwest of Coffee P. O. in the high mountains, and reached only by trail. Fifteen years ago it was equipped with a 2-stamp mill, operated by an 8-h.p. gasoline engine. Some production was made, but for several years the property has been idle due to the death of a former operator, and has been for sale.

Liberty Group of six claims extends along Boulder Creek, a tributary of Coffee Creek, for 5500 feet beginning near the mouth less than one mile from Coffee P. O. Geologically the claims resemble the Golden Jubilee, which adjoins on the east. A shaft, now nearly full of water, is reported to be 145 feet deep and is said to show a vein averaging 20 inches wide, which gives high assays. Drifts 30 feet long have been run each way on the vein from this shaft, and a short adit has been run. High grade ore of a total value of $7,000 is said to have been sorted and shipped during the sinking and drifting work, years ago. Lately the claims have been idle. The ore carries tellurides and sulphides. There is some ore on the dump, but probably it is not high grade enough to repay the cost of hauling, shipment and smelter treatment, which would be $25 a ton or more.

---

[1] Brown, G. Chester, Cal. State Min. Bur. R. XIV, pp. 892–893.
[2] Mac Donald, D. F., Bull. U. S. Geol. Survey No. 530 D, p. 17.

There is no reduction equipment. Water is available in Boulder Creek for power and milling.

McClaren Group (*Trinity Group, Last Chance and Mountain Bell*) is 14 miles north of Helena of which distance one-half is by trail from the Yellowstone Mine. The East Branch of East Fork crosses the claims which cover 4500 feet on the strike. The principal work at present is on Trinity No. 1 claim. An adit from the south bank of the creek is on a vein averaging 15 inches wide for a length of 105 feet, when quartz pinches for 50 feet. On the north bank, at an elevation of 2650 (aneroid) an adit runs N. 35° E. for a length of 250 feet on the vein, which stands nearly vertically and has a width of 36 inches near the portal, but is narrower inside. The wall rock is micaceous and amphibolitic schist, containing considerable limestone. Winzes have been sunk 31 feet and 41 feet deep, respectively, in the south and north drifts. The owner states that an average width of 13 inches of quartz showed an average value of $16 a ton in gold for 133 feet in the north drift and 105 feet in south drift, and ore is 16 inches wide and assays $16 a ton in the north winze. The ore shows a little free gold and small amount of sulphides and is reported to carry telluride in places.

On the Mountain Bell claim an adit was run 300 feet and for 130 feet followed a vein reported to be four feet wide and to assay $9.72 a ton. An adit 60 feet long has been run on the Last Chance claim, showing 30 inches of quartz, and shallow work has been done on other claims. The owner works alone. There is ample timber on the claims and water for milling in the East Branch.

Paul Patillo Prospect comprises three unpatented quartz claims called Snowshoe, San Miguel and Montezuma, 60 acres, at the head of West Weaver Creek, on south slope of Weaver Bally, and adjoining Fields-Meckel prospect, 12 miles from Weaverville and accessible only by trail.

The vein strikes N. 75° E. and is being prospected by short adits, the longest having been driven 50 feet as a crosscut and 20 feet on the vein at time of visit in August. The vein makes small lenses similar to those in the Fields-Meckel claims, and is probably an extension of the same vein. It carries finely divided free gold. Assessment work only is done.

Rainbow Prospect is near the Bully Choop road, three miles north of Bully Choop mine. In the autumn of 1925, the owner, D. C. Dedrick, was prospecting a flat blanket ledge, which in places was three feet wide, with serpentine hangingwall and birdseye porphyry footwall. The vein outcrops at intervals for 500 feet, striking northwest and dipping east. Good pan prospects are obtainable at several places in the soft oxidized upper portion and in the gossan. The shallow adits and pits are on a steep hillside and the vein is broken and not yet proven for any distance underground, but appears promising.

Sunshine Prospect is one-fourth mile west of Coffee P. O. and belongs to John Rau. There is a drift 75 feet long on a vein assaying $7.80 a ton. It lies between granodiorite walls and is geologically similar to the Golden Jubilee.

Trinity Bonanza King Mine (United Trinity Mines) is about ten miles by road northeast of Trinity Center and is 36 miles by road from Delta. The lower workings and camp are on a steep mountainside at an elevation of 5200 feet, and may be reached by automobile during the dry season. The outcrop of vein is 1000 feet higher than No. 7 adit, which is on the same level as the camp. The entire holdings comprise about 2800 acres, including Bonanza King and Bonanza Queen groups of 116 quartz claims and 28 millsite claims, and the Bugle Hill Placer of 320 acres. The quartz claims extend in a northwesterly direction from the East Fork of Trinity River in section 30, T. 37 N., R. 6 W., for 4½ miles. Bugle Hill Placer comprises the south one-half of section 36, T. 37 N., R. 7 W. Only part of the holdings are patented.

The mine was worked 35 years ago by Vollmers and associates of Trinity Center, and had a 5-stamp mill. It was purchased in 1904 by James Treadwell and operated by him until the early part of 1907. A hydro-electric plant of 1000 h.p. capacity was erected on the East Fork and a power line seven miles long was built to the mine, where a 40-stamp mill and other buildings were erected. It is claimed that during his operations Treadwell produced $1,250,000. Part of this came from rich pocket shoots found at intersections. Two of these yielded $85,000 and $240,000 respectively. The mine lay idle between 1907 and June, 1912, when work was resumed, and low grade ore was milled. In January, 1913, a snowslide wrecked the mill and killed two men. Since that time, operations have been rather irregular and have produced little. Twenty stamps of the mill were salvaged and placed at the present site, with boarding house, bunkhouse, office, blacksmith shop and other buildings grouped about it.

In the lowest or No. 7 level the vein shows a maximum width of nine feet of white quartz. It occurs in a shear zone in chlorite schist. The country rocks are gabbro and andesite, altered and sheared, and traversed by basic dikes. Serpentine and talc schist are prominent on this level. No. 7 is a crosscut 1373 feet to the vein, with a drift thence 890 feet northwest and 400 feet southeast. On the northwest a serpentine dike 50 feet wide cuts across the workings near the face and nothing has been found beyond it, although considerable prospecting has been done here. The southeast face is also in schist and serpentine, and the mineralization is supposed to be connected with the serpentine. The southeast drift was presumably run to connect with a drift run 1500 feet northwest from the Bonanza Queen side, but the connection has not been completed. A raise 350 feet long from No. 7 connects with No. 3 level. The old No. 2, No. 3 and No. 4 intermediate levels are in this block of ground, but are caved and have not been opened by the present company. Above the old No. 4 intermediate level, which is 76 feet below No. 3 level, most of the vein was stoped for a length of 400 feet and a height of 40 feet. No stoping is reported below this.

No. 3 level is a crosscut 513 feet to the vein, then drifted 175 feet southeast and 600 feet northwest, of which 250 feet of the latter was new work done by the present company up to November 1, 1925, after catching up and retimbering the old drifts. They report this shows a fissure five feet wide, with ore for a length of 50 feet in the top of the drift.

Former operators stoped for a length of 350 feet above No. 3, and to a height of 25 to 35 feet; also for a similar length and height above No. 2 level, which is 210 feet above No. 3. It is about 600 feet on the dip of vein from No. 3 to the outcrop. The big bonanza shoot was found on No. 2 level and this shoot and another pocket shoot are thought to rake northwest, judging from the location of 'high grade.' The present aim is to extend No. 3 level northwest. Ore in the upper levels is said to have been under and beyond the serpentine dike.

During the past year considerable work has been done on the dam, flume and power line, and the available power supply permitted running the compressor and mill only one shift each. Work underground besides that done on No. 3 level was mostly putting up raises and retimbering old drifts. Four new raises, each 76 feet long, were put up from No. 4 to No. 3, and furnished 60 per cent of rock milled. No. 6 level was reopened for 225 feet, and new track laid. About 1000 tons, not all ore, was milled between March and November, 1925. Twenty men have been employed. Electric power is used throughout, including electric haulage of ore. The use of No. 7 level and raise does away with the need of an outside tram. The mill uses amalgamation only, and tailing runs to waste.

Trinity Mohawk Group of claims has been actively prospected during 1925. Ore for mill tests has been mined and hauled. The property was described in our monthly, MINING IN CALIFORNIA for October, 1922, and as this booklet is still available, it is not thought necessary to repeat a full description here. The property includes 11 claims and the Golden Oaks Group of three claims under the same ownership adjoins. On the Trinity Mohawk claims, a series of quartz veins occur on the contact of the black Bragdon slate and intrusive dikes of 'diorite porphyry.'

Yellow Rose Mine is partly in Trinity and partly in Siskiyou County, 16 miles by trail southwest of Coffee P. O. and 26 miles from Trinity Center. It was leased, in 1925, to C. J. Kerr and work was resumed after a long idleness. The mine is at an elevation of 6500 feet to 7000 feet near the top of the divide between Coffee Creek and South Fork of Salmon River. There are three claims.

The country rock is serpentine, which is traversed by numerous lamprophyre dikes. One of these dikes, 60 feet wide and striking N. 10°–16° E. with a dip of 75° W. forms the hangingwall of the deposit. This dike is locally called 'crows-foot porphyry,' but according to Mac Donald[1] has about the composition of camptonite on the east side, and kersantite on the west. The ore zone is in a prominent fault. The soft oxidized material has yielded some very rich ore. The property was discovered in 1897 by Hill and Farmer while 'pocket hunting' and the first reduction plant was an arrastra. According to John Boddecker, some ore worth $1,800 a ton was shipped. This occurred in a strip 20 feet long in a lens 140 feet in length, and was probably at the intersection of a cross fissure. Production so far has been all in free gold, but pyrite, galena and tellurides are reported in depth. A 3½-foot Huntington mill, using steam power, was employed, and the total output is placed at $75,000.

---

[1] Op. cit., p. 9.

The mine was developed by four adits. The lowest of these is 1400 feet long, and gives a depth of 450 feet on the vein. The next above is 170 feet higher and 710 feet long. The ground is soft, requiring timber. The vein varies from two to six feet in width. The present work is in a crosscut 650 feet long. There are reported to be backs of 345 feet left unworked on the vein above the lowest level, and there is still considerable length of unexplored vein between this mine and the nearest workings of the Dorleska Mine, which adjoins on the north. It is estimated that an adit 4500 feet long from the Taylor Fork of Salmon River would give 2000 feet of backs on the vein.

Yellowstone Mine of three patented claims adjoining the Enterprise Mine has been leased to the same parties as the latter.

This mine, a former producer with a record of $160,000 to $190,000 output has been idle for many years. It was developed by extensive workings, none at a very great depth, and a large shallow kidney of ore was mined. "A" level was run 780 feet following course of vein, east of northeast, and "B" level 680 feet above "A." Five other shorter adits were driven above these, the longest of them 400 feet. On "B" level, crosscuts were also run 120 feet northwest and 320 feet southeast in search of more ore. At this late date no definite information is available as to the mine's geology, and all workings are caved. The mill and other buildings and equipment long since fell to ruins.

TABLE OF QUARTZ MINES AND PROSPECTS, TRINITY COUNTY.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Alaska	15	35 N.	11 W.	R. H. Junkans, F. Shaw, Weaverville, and P. Zuella, Helena	3,100	120	R. XI, p. 482; XIII, p. 137; XIV, p. 884.
Amy Balch	13	33 N.	8 W.	M. G. Carter and B. C. Blair, 25 Willis St., Redding	3,400	80	R. XIII, p. 137; XIV, p. 884.
*Annie McGrew				See Star of the East.			
Armstrong	6	37 N.	12 W.	J. E. Miller	3,400	40	R. XIII, p. 137; XIV, p. 884.
Big Chief	16	8 N.	8 E.	Ladd Brothers	3,800	40	R. XIV, p. 884.
Bigelow	15, 16	34 N.	10 W.	J. E. Henry	4,300	20	R. XIV, p. 884.
*Bismarck	12, 13	33 N.	8 W.	Chas. Dobler, L. C. Lewis, 3978 Twenty-sixth St., San Francisco	3,500	15	
Blagrave	8	37 N.	7 W.	Estate of George H. Blagrave, Carrville		20	
Blue Jacket	17, 18	37 N.	7 W.	Adams Exploration Company	3,000	450	R. XIII, p. 439; XIV, p. 884; U. S. G. S. Bull. 530 D., p. 21.
Blue Jay	13	37 N.	8 W.	See New Blue Jay Mining Co.			
Boarding House	22	35 N.	8 W.	L. N. Dennison, Minersville		40	
Bonanza	29	35 N.	8 W.	J. H. Tourtellotte, Weaverville	2,700	40	R. XI, p. 483; XII, p. 307; XIII, p. 439; XIV, p. 885.
Bonanza	10	35 N.	11 W.	J. L. Johnston, Helena	3,000	105	R. XIV, p. 885; XVIII, p. 207.
Bonanza King	14	37 N.	7 W.	United Trinity Mines, 564 Market St., San Francisco	6,500	2,500	R. XIII, p. 440; XIV, p. 876; XVII, p. 539; Pre. Rep. No. 8, p. 18; U. S. G. S. Bull. 530.
*Boston				See Star of the East.			
*Boulder Cons. G. Mines Co.	7, 8	38 N.	5 W.	Boulder Cons. G. Mines, 2401 Cimarron St., Los Angeles	6,000	161	
*Brooks Lode	24	9 W.	7 E.	Percy Grace		20	
*Brown Bear	11, 12, 13, 14, 16, 24	33 N.	8 W.	Thos. McDonald, R. A. Foster and Ella M. Smith, French Gulch	3,500	1,122	R. VIII, p. 639; X, p. 713; XI, pp. 483-84; XII, p. 308; XIII, pp. 440-41; XIV, pp. 885-86; U. S. G. S. Bull. No. 540, pp. 70-71.
Buck Mine	14	32 N.	9 W.	J. W. Phillips, Lewiston	2,900	40	R. VIII, p. 653; XIV, p. 886.

Bully Choop	4, 5, 8, 9	31 N.	8 W.	Bully Choop G. Mg. and Power Co., 805-6 Empire Bldg., Atlanta, Georgia	5,000	491	R. VIII, p. 640; XII, p. 308; XIII, p. 441; XIV, p. 886; XX, p. 182.
Carrie	5	37 N.	12 W.	G. Ferney	4,600	20	R. XIII, pp. 441-42; XIV, p. 886.
Chapman	33	38 N.	8 W.	W. Chapman	3,700	60	R. XIV, p. 886.
*Cleveland	4, 9, 16	31 N.	8 W.	Cleveland Consolidated Mining Company, Red Bluff	5,800	100	R. XII, p. 310; XIII, p. 442; XIV, p. 887.
Craig	4, 5 32, 33	34 N. 35 N.	10 W. 10 W.	Craig Mining Company, F. A. Hebbard et al., Dedrick, lessees	4,200	100	R. XIV, p. 887; U. S. G. S. Bull. 540, p. 78.
*Daisy	5	33 N.	8 W.	H. S. Blakemore, J. A. and E. L. Yates, M. A. Tanner, Box 547, Wilmington	1,960	16	R. XIII, p. 443.
Democrat Group	12, 13	33 N.	10 W.	R. H. Junkans, C. J. Hanna, D. E. Ryan, Weaverville	2,350	243	
Dixie Queen	14, 23	32 N.	9 W.	Morris Brothers, Indian Creek, via Douglas City	2,700	20	R. XIV, p. 887.
Dorleska	15, 16	38 N.	9 W.				
	21	37 N.	9 W.	Carr and Kingsbury, Carrville	6,550	480	
Enterprise	4, 5	35 N.	11 W.	W. R. Bigelow, Weaverville	2,100	160	R. VIII, p. 643; X, p. 710; XI, p. 482; XIII, pp. 446, 454; XIV, pp. 887-88; XVIII, p. 207; Pre. Rep. No. 8, p. 18.
Eureka	33	35 N.	10 W.	Maple Creek Mining Company, Weaverville	4,500	120	R. XIV, p. 888.
Excelsior	9	31 N.	8 W.		5,560		R. XIII, p. 446.
Excelsior	5, 8	37 N.	12 W.	Harris and Colegrave	4,800	80	R. X, p. 715; XIII, p. 446; XIV, p. 888.
Fairview	3, 10, 11	34 N.	8 W.	Fairview Mining Company, 216 Pine St., San Francisco	2,000	852	R. XIV, p. 888; U. S. G. S. Bull. 540, pp. 75-76.
Fields-Meckel	un	surveyed		Dr. D. B. Fields, A. C. Meckel et al., Weaverville	5,900	171	
Five Pines	19, 20, 29	35 N.	7 W.	Lester, Lewis and Elbert Van Ness, 3551 Wilson Ave., Oakland	2,100	183	R. XIV, p. 889; XVIII, p. 355; Pre. Rep. No. 8, p. 18; U. S. G. S. Bull. 540, pp. 73-74.
*Forget Me Not	8, 9	37 N.	7 W.	Mary J. Carr, Carrville	3,500	40	R. XIII, p. 446; XIV, p. 889.
*Foster Group	4, 9, 16	31 N.	8 W.	C. F. Foster Company, Corning	5,000	125	
Fountain Head	4	34 N.	11 W.	R. Ellson	3,000	40	R. XIII, p. 447; XIV, p. 889.
Four Point	32	35 N.	10 W.	H. C. Stofer et al., Helena	5,200	40	R. XIV, p. 889.
Gifford	3	33 N.	8 W.	J. F. Gifford, Lewiston	3,050	70	R. XVIII, p. 497.

---

*Indicates property patented or surveyed for patent, according to county records.

[1] Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF QUARTZ MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			[1] Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Globe Cons.	15, 16, 21	35 N.	10 W.	F. K. Reed, Lewiston	5,500	200	R. X, pp. 711-12; XI, p. 483; XII, pp. 309-10; 310; XIII, pp. 432, 442, 447; XIV, pp. 889-91; XVII, p. 540; U. S. G. S. Bull. 540, pp. 76-78.
Golden Chest	9	35 N.	11 W.	Boyce et al., J. L. Johnston, Helena	3,300	40	R. VIII, p. 641; X, p. 711; XIII, p. 447; XIV, p. 891.
Golden Jubilee	4	37 N.	8 W.	McCormick-Saeltzer Company, Redding	3,090	180	R. XIV, p. 891; XVII, p. 540; Pre. Rep. No. 8, p. 18; U. S. G. S. Bull. 530 D, p. 27.
Golden Star.	2	33 N.	10 W.	B. R. Brown et al., Weaverville	--	40	
Gold Leaf	-	--	---			-	R. XII, p. 311; XIII, p. 447; XVIII, p. 298.
Graig	4	31 N.	11 W.	Wm., John and James Meredith et al.		48	
Hardtack	6	37 N.	12 W.	T. J. Ladd	4,700	40	R. XIII, p. 448; XIV, p. 892.
Hardscrabble.	15	38 N.	9 W.	John Keating and Ann Edwards, c/o Scott Valley Bank, Etna Mills	6,000	80	U. S. G. S. Bull. 530 D, p. 35.
Hard Times	6	37 N.	12 W.	E. C. Miller	4,400	60	R. XIII, p. 448; XIV, p. 892.
Hayfork	18	31 N.	11 W.	Dr. C. A. Mueller, Redding	3,400	100	R. XIV, p. 892; XVIII, p. 600.
Headlight	20, 21	37 N.	7 W.	Trinity Gold Mining and Reduction Company, 311 California St., San Francisco	3,500	124	R. XIII, p. 449; XIV, p. 892; U. S. G. S. Bull. 530 D, p. 17.
Headstrom Group	9, 16	37 N.	7 W.	C. L. Headstrom, Carrville		114	
Henry Clay	11	33 N.	8 W.	Louise M. Smith, 1821 Lyon St., San Francisco	2,700	20	R. XIII, p. 447.
Hunter				J. P. Hennessy	4,500	40	R. XIII, p. 450; XIV, p. 893.
Index	28	7 N.	7 E.	John and J. E. Larsen, Sawyers Bar		160	Pre. Rep. No. 8, p. 18.
Iron Dike	18	37 N.	7 W.	Mrs. Mary J. Carr, Carrville		100	U. S. G. S. Bull. 530 D, p. 21.
Isabel	32	35 N.	10 W.	T. E. Martin	5,600	60	R. XIV, p. 893.
Jacoby	--	33 N.	9 W.	Goodyear and Richards	2,950	80	R. XIV, pp. 893-94.
Jerusalem	9	31 N.	8 W.	J. T. Lockhard	5,350	80	R. XIII, p. 450; XIV, p. 894.
*Keno	19	35 N.	7 W.	Nora V., C. W. and A. L. Thresher, O. P. Ormsby, B. F. Rogers, Gridley		227	
Lapman.	12	33 N.	8 W.	Calumet-Michigan Mining Company, Detroit, Michigan	3,500	60	R. XIV, p. 894.
Last Chance	2	33 N.	8 W.	S. T. Dean and J. Kirkpatrick, Shasta	3,500	20	R. XIV, p. 894.

Laurel	14	32 N.	9 W.	J. Walter Phillips, Lewiston	2,500	63	R. XIV, p. 894; XVII, p. 541.
Layman	29	32 N.	11 W.	T. A., C., and A. Layman and Benjamin Murphy, Hayfork	3,000	180	R. XIV, p. 894; XVIII, pp. 207, 600.
Lila	12	33 N.	8 W.	T. E. Thurner and Estate T. Gruss, Weed	3,700	17	
Little Buster				Frank Gallaher, West Point, P.O. Lewiston			R. XVII, p. 540.
Maple	1	34 N.	11 W.	T. E. Reed	3,500	20	R. XII, p. 312; XIII, p. 155; XIV, p. 894.
May Blossom	16	34 N.	8 W.	Joseph and George Kapusta, Lewiston	2,500	40	R. XVII, p. 540.
McClaren Group	10	35 N.	11 W.	W. J. McClaren, Helena	2,650	60	
Modoc	31	9 N.	7 E.	G. W. Healey	4,850	20	R. XIII, p. 456; XIV, p. 895
Monarch	18	36 N.	9 W.	J. B. Morrison, R. H. Bailey and J. T. Putney, Los Angeles		160	
*Montezuma	12, 13	33 N.	8 W.	Niagara Summit Mining Company, c/o W. D. Tillotson, Redding		21	
*Morning Star	31	38 N.	9 W.	Maud B. Decker, Box 236, Madison Square Station, New York		15	
*Morning Star	3	34 N.	11 W.	Jos. Walters, 224 Brunette St., New Westminster, B. C.		15	
Mountain Boomer	5	37 N.	12 W.	Bobs Farm Mining Company, Sacramento.	5,000	100	R. X, p. 715; XIV, p. 895; Bull. 92, p. 93.
Nely Thomas	7	37 N.	9 W.	Nely Thomas, Coffee P. O.		105	
*New Blue Jay Mining Co.	13	37 N.	8 W.	New Blue Jay Mining Company, 3320 Geary St., San Francisco	2,700	93	R. XIV, p. 885; XVII, p. 541; U. S. G. S. Bull. 530 D.
Nonpareil	9	37 N.	7 W.	Strode Brothers	2,600	40	R. XIV, p. 895.
North Star	32 5	35 - 34 N.	11 W. 11 W	Estate of R. A. Skinner, Weaverville	2,200	80	R. VIII, p. 642; X, p. 710; XI, p. 482; XIII, p. 458; XIV, p. 895
Oriole	22	32 N.	9 W.	A. L. Paulsen	2,750	40	R. XIV, p. 896.
Ozark	4, 9	34 N.	11 W.	D. G. Reid	2,200	40	R. XI, p. 482; XIII, p. 459; XIV, p. 896.
Phillips Group	14	32 N.	9 W.	J. W. Phillips, Lewiston (See also Laurel)	2,000	63	R. XVII, p. 541.
*Pound Cake	8, 9	31 N.	8 W.	H. E. Cotton; Ada M. Ellery, 5915 Claremont Ave., Oakland; S. M. Gibson, Weaverville	5,000	16	
Quimby	22	7 N.	13 W.	Larsen Brothers, Sawyers Bar	2,260	160	R. XIV, p. 896.
Rainbow	32	32 N.	8 W.	D. C. Dedrick, Douglas City	3,000	40	
Ralston	32	35 N.	10 W.	Trinity County Bank	4,500	40	R. XIV, p. 897.
Ray	12	33 N.	8 W.	Danners and Hollensworth	2,400	80	R. XIII, p. 460; XIV, p. 897
Readjuster	33, 34 -	34 N.	8 W.	William Richards, Lewiston		25	
Rebel	31	29 N.	12 W.	Jack Hoffman, Forest Glen			R. XVIII, p. 92.

---

*Indicates property patented or surveyed for patent, according to county records.

[1] Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF QUARTZ MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			[1] Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Red Bluff				Chas. W. Kidder et al., 607 Chestnut St., Redding		20	
Reindeer	3	37 N.	8 W.	Wagner Mining Company, Berkeley	2,900	60	R. XIII, p. 461; XIV, p. 897.
Ridgeway	6 31	37– 38 N.	12 W. 12 W.	Ridgeway Mining Company, Weaverville	4,750	80	R. X, p. 715; XIII, p. 461; XIV, p. 897.
San Miguel et al.				Paul Potillo, Weaverville		60	R. XVII, p. 542.
Sherwood Group	32	8 N.	8 E.	James W. and John H. Bartlett, Denny	4,450	80	R. X, p. 715; XIII, p. 462; XVII, p. 542.
*Shoo Fly	11	33 N.	8 W.	Thos. McDonald, A. A. Skinner, W. P. Sargeant and L. S. Smith, French Gulch		20	
Silver Grey	33	35 N.	10 W.	R. L. Carter et al.	5,200	40	R. XII, p. 313; XIII, p. 462; XIV, p. 897.
Smith	19, 30, 31	36 N.	9 W.	Paulson and Blake	3,900	274	R. XI, p. 483; XIII, p. 462; XIV, p. 898.
Smith Cromwell				S. H. Parkhurst			R. XVII, p. 542.
Spratt and Ingram	2	32 N.	19 W.	Dr. C. W. Spratt and Jeff Ingram, Weaverville			
*Star of the East et al.	13	33 N.	8 W.	M. F. Bacon, J. M. Griffith, H. R. Brown, D. M. Sinclair, 1048 Armada Drive, Pasadena	3,700	70	R. XIV, p. 898.
Strode	8, 9	37 N.	7 W.	Strode Mines Company, 626 Fourth Ave., Milwaukee, Wisconsin	2,600	280	R. XII, p. 313; XIII, pp. 458-59; XIV, p. 896; XVIII, pp. 207, 257, 600; XX, p. 182; U. S. G. S. Bull. 530 D.
Sunny Slope		34 N.	8 W.	Sunny Slope Mines Company, French Gulch			R. XVII, p. 542.
Supplanter	23	7 N.	13 W.	J. and G. Foutes	2,600		R. XIV, p. 898.
Thorne				See Star of the East.			
Tom Morton Cons. et al.	20, 28, 32	37 N.	6 W.	J. J. Daugherty et al., 151 Clark Building, Canton, Ohio		304	
Toughnut	6	37 N.	12 W.	Tough Nut Company, Denny P.O.	4,500	20	R. X, p. 715; XIII, p. 464; XIV, p. 898.
Triangle	11	33 N.	8 W.	J. Hollingsworth	3,600	40	R. XIV, p. 898.
Trinity Mohawk		34 N.	8 W.	J. H. King, Redding or French Gulch	3,880	280	R. XVIII, p. 498.

*True Blue	20	37 N.	7 W.	Gustave La Blanc	3,700	12	R. XIV, p. 900; U. S. G. S. Bull. 530 D.
*True Fissure	15	35 N.	10 W.	Bank of Tehama	----	40	R. XIV, p. 900.
Uncle Sam	5 32	8 9 N.	8 E. 8 E.	J. Cullich	4,500	80	R. X, p. 715; XIII, p. 465; XIV p. 900.
*Van Ness Group				See Five Pines.			
*Venecia	3	33 N.	8 W.	Charles, H. W., F. R. and A. E. Paulsen, Lewiston		230	R. XIV, p. 900; XVIII, p. 207, 497.
Wagner	34	38 N.	8 W.	P. A. Wagner et al., Coffee			U. S. G. S. Bull. 530 D, p. 28.
Watson Group	25	28 N.	11 W.	J. R. Watson, Knob		60	
White Cloud	3	34 N.	8 W.	J. W. Phillips		40	R. XIV, p. 900.
Yellow Aster	21, 29	35 N.	11 W.	East Fork Development and Mining Company, Boulder Creek		40	R. XIV, pp. 900-01.
Yellow Rose of Texas	20	37 N.	9 W.	Reed M. Saeltzer, Redding, and John Boddecker, Coffee	6,500	60	
Yellowstone	29, 32	35 N.	11 W.	W. R. Bigelow, Weaverville	3,000	56	R. X, p. 711; XI, p. 482; XII, p. 314; XIII, p. 466.

---

*Indicates property patented or surveyed for patent, according to county records.

[1] Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

GOLD PLACER MINES.

The following notes on individual mines and mining operations, together with the preceding introductory matter on the geology of gravel deposits and the table of placer mines and prospects, will, it is believed, give the reader a comprehensive idea of the magnitude of Trinity County's auriferous gravel resources. Because of the plentiful water supply, freedom from restrictions regarding debris disposal, the excellent climate and the presence of good roads, which give access to most of the unworked areas, this county is today probably the most attractive field in the state for the hydraulic miner who does not wish to contend with rival interests for the use of water, nor to be put to the expense of erecting debris restraining dams.

The column headed 'Bibliography' in the table gives references to our publications covering past mining operations. Many of the properties listed in the table have been worked out, but may prove of interest when some question of water rights, dump space or right of way arises. Certain water rights, for example, in the Weaverville district, claimed by companies now idle, are the key to the operation of properties belonging to others. The notes below cover numerous mines not heretofore mentioned in our reports. Due to lack of data regarding the exact location by section, township and range of certain claims in the New River watershed, these have been omitted from the table, and as that district has shown little activity for many years, and recent work has been on a very small scale, the reader is referred to our Bulletin No. 92, pages 92 and 93, where mention is made of placer deposits in that region. With this exception, the report is intended to serve as a complete index of the county's placers.

The Weaverville Basin, Trinity County, looking from La Grange Hill toward Weaverville.

Beaudry (Bazet) *Mine* at old Minersville promised to be active on a large scale as a hydraulic mine this season, but litigation with Nugget Bar Placers over water rights has intervened to delay work. The property had been idle for a long time previously on account of litigation. In the past year considerable work has been done in refitting it.

Brizard Ranch (Hawkins Bar) contains 340 acres, in part covered by high bench gravel, on the north side of Trinity River five miles upstream from Salyer P. O. at Hawkins Bar. No mining is being done now. At the ranch buildings the gravel is exposed without overburden except a light soil layer. The Irving and Oro Corono properties, containing parts of the same bench gravel deposits, adjoin on the west.

Camzo Mine is a 20-acre placer claim on the east side of the South Fork of Trinity River, 2½ miles from Salyer P. O. The owners, F. M. Tyler, R. P. and E. K. Zoller, have been working with a small centrifugal pump and gasoline engine, pumping the shallow gravel from a small bar into the sluices and have reported good returns.

Costa Placer Mine is on Rush Creek near the Weaverville-Minersville road, about eight miles north of Weaverville. The owners operate it as a hydraulic mine using water from Rush Creek and one giant. The present water supply is small and the season short, but more water is claimed than is being used, and could be brought in by ditch.

The deposit is the gravel along Rush Creek, which has eroded the old Tertiary high channel on Buckeye plateau and reconcentrated the gold sufficiently to make payable gravel. It is only a short distance above the present stream. Besides this property of 40 acres which is partly devoted to farming, the same owners have other undeveloped property nearby.

Dannenbrink Group of placer mining claims along Canyon Creek in the vicinity of Dedrick were under lease and option in 1923 and 1924 to Pittsburg-Comstock Mines Company, whose operations were described in our report of September, 1923, since which work ceased.

Elbert Nickerson Placer is a 20-acre drift mine on main Coffee Creek seven miles upstream from Coffee P. O., the last 4½ miles being trail. Nickerson is working through a tunnel and making a small production.

Fowler Placer Mine is on Coffee Creek 2¾ miles by road upstream from Coffee P. O. This 20-acre claim has been worked at intervals for 40 years. F. A. Fowler has lately sunk a flat incline 150 feet long giving a depth of 11 feet below the present stream and has run about 100 feet of prospect drifts. A little gold is produced. There are a small hoist and pump, operated by water power.

George Zinn has a small hydraulic mine on the South Fork of Coffee Creek 13 miles west of Coffee P. O. Snow water is used for washing in spring as the water supply is limited.

Hammer and Kahlke Group (South Fork Gold and Platinum Mining Company). This property comprises 895 acres, covering bench and bar deposits along the main Trinity River and the South Fork, and extends for seven-eighths mile along the main stream.

The property was described in detail by the writer in our Bulletin 85.[1] Since that report was written, very little has been done to develop the claims. The owners have been unable to finance the installation of an adequate water system and have continued work on a very limited scale, as described in the following notes, which are taken from the bulletin mentioned:

---

[1] Logan, C. A., Cal. State Min. Bur. Bull. 85, pp. 86–88.

"The complete set of gravel covered benches appear on the Hammer property, of which P. P. Hammer of Salyer is principal owner. These holdings comprise 895 acres lying between the main Trinity and its South Fork, with a length of seven-eighths mile up the main stream. The highest or sixth bench, 1000 feet above the river, is unprospected, but there is probably one-half mile of it here. The fifth bench is 841 feet above the water and has been traced for about one mile. It has been mined a little; about one-fourth acre has been hydraulicked by Mr. Hammer and has proven to be good ground. The fourth bench has not been worked or thoroughly prospected. Its edges show occasionally as a bare rocky platform on the road up the South Fork. The third bench has been extensively prospected and has been mined on the Hammer property and on the adjoining properties lying on the east bank of the South Fork. This channel has a length of three-fourths mile and has proven to be productive ground. The gravel is 47 to 50 feet deep with no overburden. The floor of this bench is about 450 feet (aneroid) above the river. The bench is prominently developed clear across the area between the two branches of the river. The second bench has been tested by shafts and tunnels and found to carry from 8¢ to 20¢ a cubic yard. This bench passes under the house of an adjoining landowner, who contested the mineral character of the land. The suit brought out evidence showing that the entire Hammer holdings are mineral land. Some samples from the second bench went as high as $3 a cubic yard. This bench has been mined in a small way on the opposite side of the river from the Martin house, and yielded satisfactorily. The first, or lowest bench, has not been mined on this property, but higher upstream has been proven productive. This bench is well developed around the mouth of the South Fork, where the present stream flows in a steep canon cut in the rocks to a depth of 60 to 70 feet below the first bench. These six terraces are thought to represent the entire series of stages of the downcutting Quaternary Trinity River. Not all of them, probably, occur so conveniently situated for observation anywhere else on the river, although as many as three or four can be seen at places like Junction City.

"As little known as these bench gravels are, they have been mined enough to indicate that they are probably richer in platinum than any other known area of mining ground in the state. The platinum on the Hammer ground is coarser than would be expected so far downstream, and evidently contains a large proportion of osmiridium. As noted above, Hammer is operating two small hydraulic mines on his holdings. One is on the fifth bench, where Dutchman's Gulch cuts through the gravel. One-fourth acre of ground has been mined here, which Hammer says has yielded $6,000 and has given as much as four ounces of platinum for $1,000 in gold. In one 50-hour run with a 6-inch pipe and 3-inch nozzle, nearly one ounce of platinum was saved. The gold is flat, ranging around the size of wheat. Platinum flakes the size of two pinheads are common, and both gold and platinum are clean and bright. Nearly 15 ounces of platinum are said to have been produced from this ground. The very high proportion of the platinum to the gold can be realized when it is remembered that 15 ounces represent the average yearly production of platinum from two California dredgers handling from 200,000 to 240,000 cubic yards a month.

"On the South Fork, possibly a mile upstream from the mouth, Hammer has opened a mine in the gravel of the third bench and has found ground which has yielded well. The bedrock is slate. Where now working, the gravel is 30 feet deep, but increases to 47 feet nearby. There are two strata of gravel in the bank, colored red and blue; the latter is the richer, and has shown a value of 37¢ a cubic yard as against 18¢ for the red phase, where they were prospected by shaft. The recovery from the ground actually mined has exceeded these prospects as Mr. Hammer claims to have realized over 60¢ a yard. The gold is in flakes of medium size, seldom smaller than No. 2. Platinum colors can be easily panned on the bedrock. They range from very fine to No. 2 size. The amount of ground moved here has been small, because very little water is available.

"Failure to work these holdings on a larger scale has been due to lack of water, and to adverse claims of agriculturists. * * * The problem of water supply has been the chief difficulty. There are no streams nearby high enough to put water on the fifth bench. The only water now available there is the run off during the winter rains. Two miles of ditches have been dug to encircle the hill 80 feet above this bench, and these ditches serve as reservoirs which permit washing with one giant during wet weather. It is estimated that a water supply sufficient for six months steady piping anywhere on the 895 acres could be obtained from Eltapom Creek, a branch of Hayfork, by building 18 miles of ditch and flume. For a full year's supply it is thought that it would be necessary to tap the Hayfork at a distance of 34 miles. A siphon from Campbell Creek would furnish a supply for the third bench gravel. * * * The gravel is loose and easily worked and there is ample grade with plenty of space for dump."

Henninger Brothers Placer adjoins Elbert Nickerson Placer upstream. They are ground sluicing.

Hook and Ladder Mine is adjacent to the town of Weaverville on the north. It has been worked intermittently in a small way as a hydraulic mine for many years and is one of the few remaining active mines in the district. The deposit is part of that filling the Weaverville Basin, composed of gravel washed down by recent streams from the higher and older deposits. The bank ranges from 20 to 30 feet in height.

During the season of 1924–25 about one acre in area was hydraulicked, giving a reported return of $7,000. This is about the same rate of yield as made previous to the war, but the costs, which totaled about $2,200 a season at that time, have greatly increased. Water is taken from the La Grange Mining Company's Rush Creek ditch through a 12-inch pipe line, and three giants are used, one for the bank, one at the head of sluice and one at the foot of sluice, on account of the lack of grade and dump.

This work was on the low ground of the Rule Channel. There is another and slightly higher gravel area on the property, and an acre or less of this has been worked, but bedrock has not been reached. Most of the Rule Channel on this property has been worked.

Howard and Campbell Placer Mine contains 35 acres, at Big Bar but on the north side of the river. On the New Year Claim there are three benches of gravel of which the lower two have been worked by the owners during the past season. The bank is 40 feet high, and rocky on top, with sand and finer gravel below, the lower 12 feet next bedrock carrying pay, with coarse gold. This claim covers a length of 600 feet along the course of channel, and there are in all only a few acres of gravel.

Water is taken from Manzanita Creek through three-fourths mile of ditch, giving 225 feet fall, with sufficient water in a good season to fill a 6-inch nozzle and permit mining from December to May. A dam 12 by 50 feet would give a better water supply by permitting storage. The owners also have one-half interest in the water of Price Creek. The reported return from the small area worked indicates good gravel, and it should be a paying property for two men for a few seasons.

Humboldt Placer Mining Company's holdings comprise 4800 acres of locations, on Buckeye Plateau between Rush Creek and Stuarts Fork, extending for several miles west and southwest of Minersville. The road up Rush Creek, after turning east toward Minersville, traverses this gravel area for several miles at an elevation of around 3000 feet.

This gravel is part of the immense accumulation of Tertiary gravel of the so-called Weaverville Basin, upon the Sherwood peneplain, and similar geologically to the other high gravel deposits previously mentioned. The company has done little toward developing their claims. A small giant and 300 feet of 8-inch pipe have been used for prospecting some of the gravel in the gulches. They have had an application before the State Division of Water Rights for two years, asking to appropriate water from Stuart Fork, but the present status of this application is not known, although it is possible that others have prior rights to most of this water.

Diller[1] wrote as follows regarding this region:

"Between Stuarts Fork and Rush Creek there is a great body of fragmental deposits made up in part of more or less angular material that suggests glacial origin but including much gravel that is well rounded by water. The main belt crossing the Buckeye Plateau lies west of Buckeye Creek. It has a width apparently

---

[1] Diller, J. S., Bull. U. S. Geol. Survey, No. 540, p. 18.

> of nearly three miles and a depth where greatest of more than 800 feet. Three shafts from 40 to 195 feet in depth have been sunk on the top portion of this deposit to test it for gold. Little if any gold is said to have been found and no actual mining tests resulted.
>
> "The surface of the Buckeye Plateau is generally reddish soil to a depth of 15 feet or more, passing downward into a sandy argillaceous mass in which the forms of rounded to subangular fragments and some boulders may be seen and a few well-rounded solid pebbles are preserved. On the plateau surface there are for the most part only a few scattered pebbles with here and there a small, well-rounded boulder, but on the slopes of the ravines cut by branches of Buckeye Creek, as well as on the plateau borders facing Rush Creek and Stuart Fork, well-rounded gravel is in many places abundant and extensive. Buckeye Creek drains the great body of fragmental material that forms the Buckeye Plateau. * * *
>
> "Rush Creek, whose present stream bed affords some good placers, cuts a deep narrow valley directly across the old channel but does not reach the bottom."

At the *Indian Creek* and *Panwocket* properties in Indian Creek district four miles from Douglas City, little work has been done since the war, but in 1925 a ditch was being extended an additional mile and a half to put water for hydraulicking on the south side of the Panwocket ground, and it was hoped this could be completed in time to permit some mining the present season. This group covers 1741 acres, containing considerable unworked ground. The owner, Dr. D. B. Fields, is developing it and plans ultimately to extend the ditch to Douglas City, where he has 820 acres more, containing good hydraulic mining ground. Equipment includes 3200 feet of iron pipe ranging in size from 13 to 22 inches, two giants, and two houses.

Ivy Gulch Placer Mine covers a frontage of one-fourth mile on the south side of Trinity River, near Big Bar Creek between Helena and Big Bar. The gravel bank, 15 to 40 feet deep, is on one of the later terraces not far from the present stream. The deposit is worked by hydraulicking on a small scale, using one giant supplied with water under 70 feet fall from Big Bar Creek.

J. A. Mac Donald of Coffee P. O. has a drift mining claim on Coffee Creek, one-fourth mile northwest of the post office. This has been opened by a shaft and a little gravel was washed and is said to have prospected, but the claim was idle in October, 1925. The gravel is heavy, free wash. The same owner has a placer claim on Coffee Creek 2½ miles west of Coffee P. O. on which he was beginning work in 1925. Water is available in Sugar Pine Creek for work on a small scale.

The *Jacob Brothers Estates* own many hydraulic mining claims in Junction City district, and among these is some of the best remaining hydraulic gravel in the region. On account of the fact that the former owners did not control enough water to operate the properties on a large scale, and were unable to secure a supply from nearby owners, they were able to work only in a small way, with about 500 miner's inches of water under low head and for a short season. Consequently only a small part of the available acreage has been worked. During the past ten years very little work has been done.

The deposit consists of terrace gravel at former levels of Trinity River on the west side of the stream two miles below Junction City. The gravel is 15 to 30 feet deep and overlain by 40 feet or more of red clay and loam. Small water rights are owned in Connor Creek and nearby gulches.

The latest work has been done the past few seasons, subsequent to the death of the last owner. The claims were leased and water for operation was leased from adjoining owners, and some short runs made.

Koon Ranch is on the South Fork of Trinity River, about two miles above its mouth. There are 50 to 60 acres of gravel here, averaging 25 feet deep. The bedrock is slate, and the gravel is medium to fine in size, and blue in color. A test run by J. A. Koon several years ago indicated a gold content of about 7½ cents a cubic yard, and nearly one-half as much platinum metals by weight as there was gold.

La Grange Mine deserves special attention because of the magnitude of the operations which were carried on there and the great amount of valuable information regarding the methods and costs of hydraulic mining made available by this work. This mine was located in 1851 as the Ward Placer, and incorporated in 1874, and worked by various companies until 1918. The acreage of holdings and scale of operations were increased under the several operators. The holdings of the company comprise several thousand acres in the vicinity of Weaverville, and between that place and Junction City, and only a relatively small area has been worked although the operations were on a larger scale than at any other hydraulic mine worked in recent years.

The part which was mined lies on the west side of the ridge, four miles west of Weaverville on the road to Junction City, and drainage is through Oregon Gulch into Trinity River. The gravel is a portion of the channel filling of the Tertiary Trinity River, covered by an immense accumulation of very low grade or nearly barren overburden. As mentioned by Mac Donald[1] and Diller[2] the gravel lies in a trough formed between a fault plane on schist on the northwest and slate and limestone bedrock on the southeast. The upper portion of deposit shows strata dipping toward the fault plane. The bedrock on the fault plane, which forms the present north rim, is a fault gouge of crushed schist and slate, and very soft. The best pay was found in a layer of blue gravel and was about 15 feet thick. This is heavy, rocky and well washed and is said to have paid up to $2 a cubic yard. Above it, and separated from it by a layer of clay, is about an equal thickness of red gravel, and a layer of cement gravel. This series of strata carry the pay and lie on the south rim of slate and extend two-thirds the distance across the channel. Covering the pay gravel, and extending across the north rim, the low grade free-wash gravel has a depth as great as 600 feet. The wash in the mine contains a variety of rocks not found in the immediate vicinity and there are many heavy boulders.

The water installation included a ditch and flume 29 miles long, of which 11 miles were flume, of truncated V-shape, nine feet wide on top, two feet wide at the bottom and five feet deep. The flume was built in 1895 at a contract price of $25 per thousand board feet in the flume. Its capacity was 3500 miner's inches and the grade was 10 feet per mile. This flume is now down, and could not be replaced at anything near the above cost. The main water supply was from Stuarts Fork, Rush Creek and Weaver Creek, but the water of several other streams was picked up on the way to the mine, and delivered to the reservoir on the ridge above the working pit.

For bank piping, it is stated that 5500 miner's inches of water, under 650 feet fall, was used in two giants. The bedrock was so soft that it was easily undercut by the giants, permitting the immense bank to cave, thus facilitating work. However, in later years the bluish clay on bedrock kept moving into the pit and up, on account of the weight above it, and they were compelled to keep piping off this barren material from the north in order to keep the flumes open. From 1905 to 1907 work on the south rim is said to have paid well, but the French company in later years worked principally in the sliding gouge and low grade overburden. The two bank giants were not moved for six years between 1912 and 1918, as the bank kept moving in, and the lower layers of better pay gravel were scarcely reached in this time. The yield in good years was about nine cents a cubic yard, but in later work went as low as 2½ cents a yard. The cost of operation in the last few years work kept increasing, and yield decreased until the two were about equal. The annual cost of operation was $80,000 to $110,000.

---

[1] Mac Donald, D. F., Bull. U. S. Geol. Survey, No. 430, p. 52.

[2] Diller, J. F., Bull. U. S. Geol. Survey, No. 470, p. 16.

Three thousand feet of sluices, four by six feet in cross section were used, on a grade of seven inches in 12 feet in the upper section and eight inches in the lower. Steel rails were used for riffles, and the sides of the boxes were lined with the bases of the rails which had previously had the tops worn off while being used as riffles. Success in saving very finely divided gold was claimed, and was ascribed to the eddying action set up by the shape of the rails. The curve of settlement for gold of different sizes was studied here. The pieces larger than 10-mesh, which comprised over one-half the total, stopped principally in boxes 11, 5, 12 and 13, the first named receiving more than the others, and the amount decreasing rapidly from box 13 onward. From 10- to 50-mesh gold stopped mostly on the way to box 12 and that box marked the maximum recovery of these sizes. Most of the gold finer than 50-mesh stopped in the first 13 boxes. The gold of all sizes which passed box 22 did not seem to settle so rapidly beyond it, but spread out over the remaining boxes. When mining was suspended in 1918, operations had reached nearly to the top of the

General view of La Grange Hydraulic Mine, near Weaverville.

ridge (elevation 3400 feet) and several changes would have been needed in order to continue mining the large remaining gravel areas owned by the company. The acreage held by the company is for the most part along the course of the Tertiary Trinity River, at elevations of from 2500 to 3000 feet, and below their own system of ditches.

La Grange Hydraulic Mine showing trough and rims of channel.

Among the promising and only slightly prospected areas held by them, is the *Musser Hill* property, along the ridge between Browns Creek and East Weaver Creek, two miles northeast of Weaverville. This covers parts of five sections and perhaps a mile and a half along the channel. It has been prospected by a few surface cuts and two adits in gravel, and this work is reported to have indicated a gold content of from four to nine cents a cubic yard. If the old main ditch were put in repair and tapped somewhere along the upper course of Rush Creek, at about the 3500-foot contour, a few miles of new ditch would give ample water and pressure for working this gravel, which lies mostly between 2500 and 3000 feet in elevation.

The La Grange property under the different owners is estimated by B. R. Brown to have produced about $8,000,000 and it contains a larger unworked area than that already mined.

Lorenz Brothers Mine is the principal operating hydraulic mine of the Weaverville district. These owners have operated each season for many years past. The gravel is along Weaver Creek, south of Weaverville, and is mostly fine and free washing. It is the result of the erosion and reconcentration of the older gravel of the higher ridges, washed down and deposited by the recent and modern streams. This stream has also been the sluiceway for the tailings from many of the old gravel mines formerly operated upstream near Weaverville. Part of the ground also contains older wash, above the present stream, and characterized by coarser boulders and red clay. The geologic history of the Weaverville Basin has been complex and not completely worked out by geologists. For a long time, subsequent to the formation of the high channel deposit of Tertiary Trinity River, that part of the so-called Weaverville Basin immediately surrounding Weaverville was a lake, in which were impounded and preserved vast accumulations of gravel, sand and clay, with lignite and other remains characteristic of such basins. Recent streams flow across this, and have very light grades.

Another view of La Grange Mine, looking southwest down Oregon Gulch. This shows the schist bedrock fault plane on northwest (light colored, right half) and slate on southeast rim. Oregon Gulch is filled to a great depth with the mine tailings.

Due to lack of grade, these operators have had to pipe much of the gravel up to the sluice boxes, and also stack tailings with another giant, three giants in all being used. They use about 3000 inches of water and work about two acres of ground each season of four to five months annually, except in years when there is ample early rainfall. The gravel ranges from 10 to 30 feet deep. The production is said to average $5,000 or more per acre. There remain perhaps 80 acres to pipe.

The same owners have interests in numerous other hydraulic mines in the county which have not been active in recent seasons.

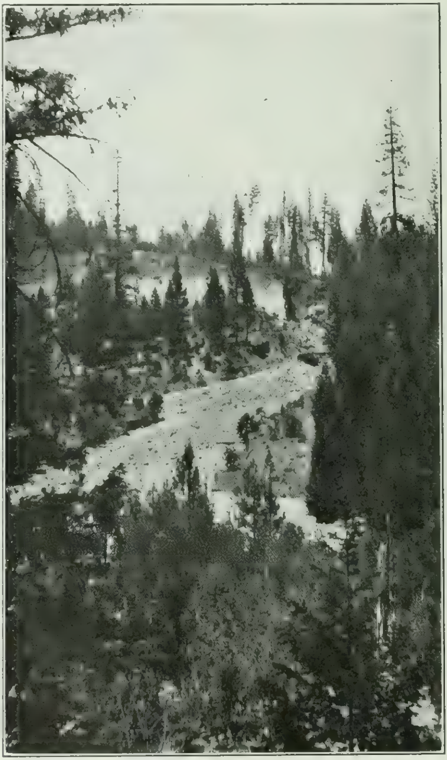
Montezuma, McGillivary, Mammoth and numerous other hydraulic mining claims, many of which have been worked extensively in years past, contain a total of 1641 acres under the ownership of W. H. Metson, Gerald O'Shay, J. S. Sullivan and others. These cover bench and bar gravels along the west and south side of Trinity River near Connor Creek and Dutch Creek. As mentioned elsewhere, the bench gravels in this section are noted for the numerous large rocks contained. Little hydraulicking has been done here in the past 10 years. These claims control five ditches and water rights in Dutch Creek, five in Connor Creek and two in Maxwell Creek, and some work has been done on the nearby Jacob Estates claims, in the past few years, using this water under lease.

Lorenz Hydraulic Mine, near Weaverville.

Nash Placer Mine (*Big Flat*, *Abrams* and *Blythe*) covers seven miles along the course of South Fork of Coffee Creek including the bed, bars and benches of the stream. The old lower workings are nine miles or more by trail from Coffee P. O. and the ground extends thence to the very headwaters of the stream, in that part of the watershed formerly drained by South Fork of Salmon River. The country rock and accumulations of debris indicate the former existence of glaciers.

The former operations were described in Reports X, XIII and XIV of the State Mineralogist. The property has been idle for many years, since the war, the last active operations having been by Trinity

Hydraulic Gold Mining Company, Ltd., of London. The ground has been partly worked by drifting, and partly by hydraulicking, elevators having been used for some of it. Tunnels and cuts have been run to drain the ground and reach bedrock, as much of it lacks grade, although good pay is claimed to have been taken out over a long period.



Nugget Bar Hydraulic Mine near Minersville.

Dredging has been suggested and in 1921 the ground was leased with this in view, but the project did not materialize.

The equipment includes giants, hydraulic elevators, pipe, old hoisting works, sawmill and buildings. Two ditches take water from the South Fork of Coffee Creek and Abrams Creek, and a total of 3000 miner's inches is available.

Nugget Bar Placers has resumed work the present season on the Van Mater Estate holdings near Minersville. Hydraulicking is going on at this time.

North Fork Mining and Hydroelectric Association of Los Angeles has under lease and option about 300 acres at and near Helena (North Fork). This includes the *Hydraulic Hill*, *Osborne* and *Schlomer* hydraulic mining properties, of which perhaps 150 acres is mining ground, on different terrace levels of the Trinity and its North Fork. This company has plans for water storage in two reservoirs, one on the East Fork of the North Fork of Trinity River nine miles from Helena, the other on the North Fork 18 miles from Helena. It is not known whether this is purely a hydroelectric power project, or if mining will also be carried on, although no actual work looking to a resumption of mining had been undertaken up to the autumn of 1925. The hydraulic mines mentioned have been idle for many years. P. W. Porter of Helena is in charge locally.

Oro Corono Placer (*Corona de Oro*) is on Trinity River, 4½ miles upstream from Salyer P. O. and near Hawkins Bar. The river flows here at an elevation of about 500 feet, and the mining claims, containing 560 acres, cover the gravel on the series of benches formed in recent and Quaternary times on the north side of the canyon, up to an elevation of 1300 feet or more.

Only a small area has been hydraulicked. Ten years ago Corono de Oro Mining Company brought water from Hawkins Bar Creek and Cedar Creek, a branch of Horse Linto Creek, through 10 miles of ditches and a tunnel 1100 feet long and used a 5-inch giant under 260 feet head for piping one of the lower bench deposits. A supply of 650 miner's inches was available for only a short season, the longest continuous run being only 12 days.[1] It was reported at that time that the gravel yielded 28 cents gold and 4.6 cents platinum group metals per cubic yard. It was believed considerable pay was lost, as both the gold and platinum metals were fine in size (the largest gold nugget being worth $5), and no undercurrent was used. J. W. Shielkie has been working the property lately under lease.

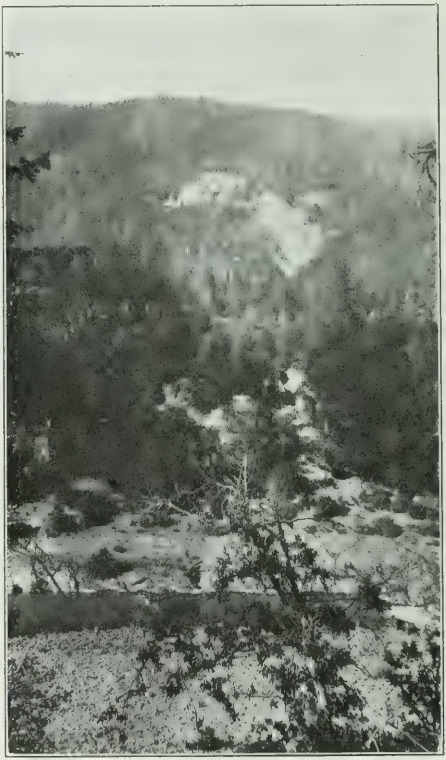
There are five or six separate benches on the claims and the upper ones are covered by heavy red overburden. There are numerous other claims adjoining, and the entire area should be of interest to the hydraulic miner. Mining has been retarded by the scarcity of water nearby, and by the expense that would be involved in bringing it from a distance. There are about 2000 acres of mineral land in this immediate vicinity, consisting of bench and bar deposits at different levels, of which only a small part has been worked.

Patrick Holland's Placer Mine is on the East Fork of Coffee Creek, eight miles from Coffee P. O. of which distance 5½ miles is steep trail. This mine has been worked every season by the present owner, Patrick Holland, for the past 50 years, making it probably the oldest active placer mine in the state. The holdings extend for 3½ miles along the East Fork, beginning one mile above its mouth. The elevation is 4100 to 4500 feet, and the working season extends from the beginning of the spring thaw, late in March or early in April, until the first heavy snow, about the first of November.

---

[1] Logan, C. A., Cal. State Min. Bur. Bull. 85, pp. 89, 90.

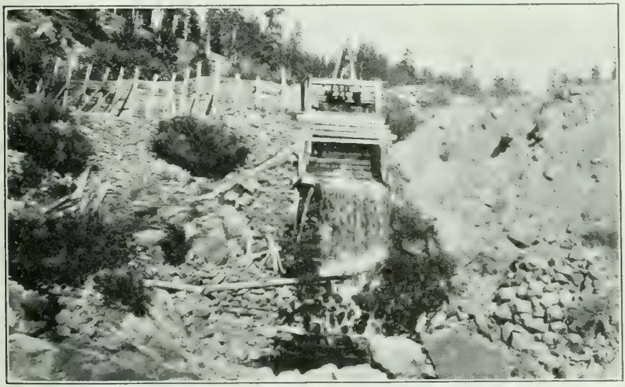
The present owner has worked three-fourths mile of the creek bed from which he produced $60,000, and some drifting has been done. Beginning in 1855–56, about 1000 feet more was worked upstream above the dam, but the output from this is unknown. During his occupancy, Holland estimates a total of about 10 seasons' time has been spent in the 'dead work' of preparing, moving equipment and the like, when no production was made. Usually only two men are employed, and many seasons the owner has worked alone.



Oro Corono Hydraulic Mine, near Salyer. Trinity River in foreground.

The deposit consists of loose and very rocky gravel in the present stream. Where work is going on the canyon is steep and narrow. A derrick is used to stack large rocks, many of which are slabby and not easily moved by water, and some have to be blasted. One ton of dynamite is used each season for blasting. The ground here is 30 feet deep, but averages 24 feet deep and 30 feet wide. Heavy rocks in the channel are stacked at the side first.

Patrick Holland Placer Mine, on East Fork of Coffee Creek, Trinity County.



'Self-shooter' reservoir, with automatic gate, Patrick Holland Placer Mine.

Water for mining is impounded in a reservoir holding five acre-feet. A 'self-shooter' or self-acting gate 12 feet wide and 14½ feet high discharges every 25 to 30 minutes, releasing a maximum of perhaps

10,000 miner's inches. This carries off gravel and sand, and probably considerable fine gold as well. This process of washing continues from the opening of the season until about August first. With the shooter about a mile above the work, as it now is, only about 10 minutes out of each 30 is available between floods of water to remove large boulders. When the thickness of the gravel in the stream bed is reduced to 2 or 3 feet, and the flow of water is becoming smaller, use of the self-shooter is stopped, and shovelling into the sluice begins. The boxes are 18 inches wide and 1 foot high, on a grade of 6 to 10 inches, and 100 to 150 inches of water are used. From 5000 to 8000 square feet of bedrock are cleaned each season. The gold recovered is mostly coarse. Numerous nuggets of good size have been found. The largest were worth about $600. The only equipment is a derrick operated by a small gas engine, the sluices and hand tools.

Schlomberger Placer is on the North Fork of Coffee Creek, eight miles from Coffee P. O., five miles being trail. The owner works the claims.

South Fork of Trinity River. Little mining has been done on the South Fork of Trinity River above the region around its mouth, which is described under the Hammer and Koon properties. Big Oak Flat in Sec. 26, T. 6 N., R. 5 E., contains 100 acres of high gravel averaging six cents a cubic yard in gold. Low grade gravel also occurs in Sec. 12., T. 5 N., R. 5 E. *Lynch Brothers* have some claims on the South Fork above the mouth of Grouse Creek but have done no work for the past season. Some work preparatory to hydraulic mining has been going on during 1925 near Auto Rest (Forest Glen) where the road from Peanut to the coast crosses the South Fork. Here the *Peacock Mining Company* of Vallejo, with G. C. Wheeler as manager, has prospected ground and has been putting in ditches and equipment. They claim to have obtained very good prospects.

Hayfork Creek, the main tributary of South Fork, enters it near Hyampom. The Hyampom Valley is a mile wide and over three miles long, and is filled with an accumulation of ancient conglomerate and sandstone, with considerable lignite. This series of beds is of Tertiary age according to Diller.[1] Above this occur deposits of later terrace and stream gravels. There are numerous placer locations along the Hayfork from the mouth up to Hayfork Valley. In this section the stream flows over bedrock, which in places visited is granodiorite, and the gravel accumulations are small and have been worked only by hand. Platinum occurs here with the gold.

Hayfork Valley contains perhaps 10,000 acres of which two-thirds are underlain by gravel, covered by soil, and forming the most extensive area of agricultural land in the county. The lower gravel is of the Tertiary period, preserved by having been faulted into a basin of harder rock.[2] At one time a busy placer mining region, supporting a large population of white and Chinese miners, the vicinity of Hayfork has shown little mining activity in the last ten years, although numerous placer locations are recorded. Several dredging companies have prospected this valley, but none has ever started operation, due probably to geologic conditions, to local sentiment, and to a disinclination to carry on pioneer work in such a remote locality.

---

[1] Diller, J. S., Bulls. U. S. Geol. Survey, Nos. 470A, 470B, 540B.

[2] Diller, J. S., Bull. U. S. Geol. Survey, No, 470, p. 21.

Diller estimated the maximum thickness of older gravel and shale here to be over 1000 feet. Some of it is cemented, as exposed in old mines on the north side of the valley. Younger gravel, 5 to 12 feet thick, has been mined a little.

Teal & Perigot Group (including *Gem Placer* or *Scharber Slough*) is on the north side of Trinity River about a mile and a half upstream from Salyer P. O. The Gem Placer has been worked in a small way for many years, using water through one mile of flume and ditch from Quinby and Scharber creeks. Part of the ground is near the present river level and with adjacent land was prospected in 1916 for dredging, but the available area was said to be too small for a large dredge and too deep for a small one. Scarcity of water in recent years has prevented much work. The equipment includes three giants, 4000 feet of pipe, a small sawmill and buildings. The *Crossover Placer*, covering unprospected high bench gravel, adjoins.

Tinsley and Treloar (*Fortune Teller*) *Placer* is at Big Bar on the south side of Trinity River. Geo. Tinsley and E. W. Treloar have owned and worked the property for many years and Treloar states the total production has been about $100,000. Possibly ten acres have been worked, although no measurements or records of yardage are available. No work has been done since 1921.

The deposit is on the second bench above the present river, and bedrock is only 50 feet above the stream, and at 1300 feet elevation. The bank is from 40 to 150 feet high, and increasing on account of the steepness of the hillside. Possibly higher benches of gravel exist, but the principal proved acreage lies between the present pits and Big Bar store and is devoted to farming, being about one-half mile in length and one of the few level areas of arable land in the district. A new bedrock cut is needed to continue operation at the upper pit.

A ditch from Price Creek supplies 600 miner's inches of water, enough for one pipe head under 80 feet pressure.

The property was under option in the autumn of 1925 to C. E. Clark of Richmond but no work was going on.

Union Hill Hydraulic Mine is near Douglas City on one of the higher and older terrace deposits 175 feet above the present river. It was first worked in 1862 but lay idle a long time until bought by the Union Hill Hydraulic Company in 1906. Water was brought in from Grass Valley Creek, and East Weaver Creek, through ditches, flumes and pipe lines for a distance of 15 miles, giving 450 feet fall and sufficient water for about six months work with two 7-inch giants. The property was finally acquired by Trinity Consolidated Hydraulic Mining Company who quit operation in 1914. Since 1922 it has been leased to T. R. Arbuckle, who employs six men in the working season.

TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY.

Name of mine	Location			†Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec	Twp	Range				
†Ackerman Group	19, 30	35 N.	10 W	John Q. Ackerman, Dedrick		39	
*Alder Gulch	15, 22	33 N	10 W	John P. Booth and Chas. Van Damme, 564 Market St., San Francisco		60	
*Alto Bert	1, 8, 9 et al	36 N. 37 N.	7 W	Estabrook Gold Dredging Company, Trinity Center		200	R. XIV, pp. 918-19; Bull. 36, p. 104; U. S. G. S. Bull. 540, p. 19
Andy	3, 9, 10	31 N.	11 W	Bert Higgins, Helena		90	
Auto	13	1 S.	7 E	A. H. Jens, Ruth		20	
*Bald Point	33	33 N.	9 W	P. M. Paulsen	2,200	120	R. XII, p. 313, XIII, p. 159; XIV, p. 904
*Barthol Jacob	1, 2, 34, 35	33 N 34 N	11 W 11 W	Estates of H. and J. Jacob, c/o F. M. Miller, Weaverville	1,700	390	R. XIV, p. 901
†Bates and Van Matre	33	31 N	8 W	J. M. McCrady, 624 Upas St., San Diego	1,800	20	R. XIII, p. 438, XIV, p. 901
Battle Peak				N. L. Hildrick, Copper			R. XVII, p. 513
Beaudry	28, 29, 32, 33	35 N	8 W	Angele Bazet, 4 Laguna St., San Francisco		3,330	R. XIV, p. 901
†Red Rock Tunnel	12	31 N	11 W	L. Heimburger, Junction City		18	
Bell Gulch	29	33 N	10 W	J. A. Gilzean, Junction City, and Geo. O. Laws, Douglas City		10	
Big Creek	7, 8	31 N	11 W	Big Creek Placer Mining Company, Oakland		58	R. XIV, pp. 901-02
†Big Dutchman	1	31 N	9 W	J. H. and E. H. Boyce, Minersville		30	
Big East Fork	30, 31	35 N	10 W	Cons. with Dannenbrink	2,300	10	R. XIV, p. 902
Bloss & McClary	5	36 N	7 W	Skeys Mining Company, Redding	2,100	136	R. X, pp. 699-700; XII, p. 307, XIII, p. 139; XIV, p. 902
Blue Gravel	1	31 N	11 W	D. E. Shuck		10	R. XIV, p. 902
Blue Jib	13	37 N	8 W	Graves and Carter	2,800	20	R. XIV, p. 916
Blue Lead	6, 31, 36	33 N 31 N	9 W 10 W	T. J. Woodbury	2,500	160	R. XIV, p. 902
Bonton	26	34 N	9 W	W. D. Carr, Lewiston		60	
Bourier Group	1 28, 33	34 N 35 N	8 W 8 W	Jos. F. Bourier, 4 Laguna St., San Francisco		180	
Bower and Matlock		31 N	11 W	M. M. Bower and James Matlock, Hayfork		90	R. XIV, p. 902
Boyd	28	8 N	8 E	A. Boyd	3,710	20	R. XIII, p. 140; XIV, p. 916.
Brown's Bar		7 N	7 W	Brackett and James Estate	1,950	140	R. XIV, p. 903
Buckeye	19	37 N	7 W	M. H. McIlwaine		40	R. XIV, p. 917
Burger	12, 13	31 N	11 W	J. A. Burger		26	R. XIV, p. 903
†Cacy et al (Casey)	26, 27	32 N	9 W	Dr. D. B. Fields, Weaverville	2,100	160	R. XIV, p. 903.

*Canada Hill	4	34 N.	8 W.	P. Burr and N. C. Richardson, Lewiston			
Carr	32	33 N.	10 W.	Geo. F. Lewman, Junction City	1,600	80	
*Carr Joseph et al.	1	32 N.	10 W.	M. C., H. C., and I. Jordan, Douglas City		34	
Clement	29	32 N.	9 W.	C. E. Clement, Douglas City	2,100	160	
*Cement and Mule Creek	30, 31, 32	35 N.	8 E.	Chas. Boyce, 455 Morse St., San Francisco, and Estate of E. S. Skewis, Minersville	2,200	350	R. XIV, p. 903.
*Chamberlain and Red Hill	13, 18	33 N.	8, 9 W.	Lawrence Gardella, c/o H. H. Bragdon, Lewiston	1,800	20	R. X, pp. 708-09; Bull. 92, p. 93
Champion				C. Bradbury and John Hagleman, Junction City			R. XVII, p. 543.
Champlain	7, 18	33 N.	9 W.	C. Bradbury and Theresa M. McDonald, Junction City		23	
*Chapman and Fisher	19 et al.	33 N.	10 W.	E. G. and G. P. Chapman, Junction City	1,600	373	R. X, p. 708; XIII, p. 442; XIV, p. 903.
China Bar	17	33 N.	6 W.	G. J. Scannell and S. Sorensen, 529 First National Bank Building, Oakland		40	
*Clayton	7, 8	33 N.	8 W.	Samuel Williams, Lewiston		120	
Clover	12	37 N.	8 W.	A. M. Daly	2,700	106	R. XIV, p. 903.
Colby and McIlwaine	16, 20, 21	38 N.	9 W.	C. F. Colby and M. H. McIlwaine, Carrville		60	
*Comstock	32	36 N.	7 W.	Fred Giddings, Haina, Hawaii	2,200	40	
Consolidated	26	32 N.	9 W.	Estate of F. R. Duarte, D. B. Fields, Henry A. and Wm. Morris, Douglas City		42	
Corono Mining Co's Group	17, 18	6 N.	6 E.	Corono Mining Company, c/o Philip Bruce, 690 Fifth St., Eureka		560	R. XIV, p. 904; Bull. 85, pp. 89-90.
Corono de Oro				See Corono Mining Company.			
*Costa	21	34 N.	9 W.	J. P. and Jesse Costa, Weaverville		40	
*Coumbs, Wallace and Ingram	31	32 N.	9 W.	S. J. Bigelow, Douglas City		140	
*Crofton	32, 5	34 N. 35 N.	9 W. 9 W.	Anna A. W. Junkans et al., Mill Valley		30	
Curley	1	31 N.	11 W.	W. Leach		99	R. XIV, p. 904.
*Daisy				See Hilliard.			
Dannenbrink	12, 13 et al.	35 N.	10 W.	Geo. A. Grotefend, Redding; D. C., August, Augusta, Henry and Estate of W. F. Dannenbrink; E. C. Edwards and Johanna Mortimer, Junction City	2,000	1,067	R. XIII, p. 444; XIV, pp. 902; 904; 906; 912; XVIII, p. 601; XIX, p. 59.
Democrat	11	33 N.	10 W.	Edward Meckel, Weaverville		40	
Democrat Gulch	13, 14, 23, 24	33 N.	10 W.	Armentrout Brothers, Weaverville		640	R. XVII, p. 543.

---

*Indicates property patented or surveyed for patent, according to county records.

[1] Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
*Dock & Kise	17	33 N.	8 W.	H. B. and L. M. Lister, 805 Pacific Bldg., San Francisco		18	
Dolly Varden	9, 16	33 N.	10 W.	A. A. and F. A. Schaffer, Junction City	2,050	48	R. XIV, p. 901.
Douglas City				Dr. D. B. Fields, Weaverville		820	
Drinkwater	13, 24	31 N.	12 W.	Drinkwater Mining Company, Oakland		100	R. XIV, p. 904.
Driver	15	33 N.	10 W.	G. D. Young	2,900	160	R. XIV, pp. 904-05.
*Dry	25	32 N.	9 W.	H. H. and Wm. Morris, Douglas City		80	
Eagan's Flat	1, 12	33 N.	11 W.	L. W. Perry, c/o R. Perry, Mills Bldg., San Francisco		56	
East Fork	1, 2, 11, 12	36 N.	7 W.	M. MacIlvaine et al	2,360	520	R. XIV, p. 905.
*Eastman	33, 34	34 N.	8 W.	J. McCrady, 624 Upas St., San Diego	2,100	263	R. XIII, p. 451; XIV, p. 905; Bull. 92, p. 95.
*Ehrman No. 1, 2	18	33 N.	8 W.	John Caton, 909 North St., Redding		40	
Elevator and Elevator No. 1	31, 32	40 N.	6 W.	J. Dodge and S. Wilbur, Carrville		340	
Ellston	7	36 N.	12 W.	R. Ellston		20	R. XIV, p. 917.
*English Tom	8	33 N.	8 W.	Trinity River Mining Company, 193 Twelfth St., Oakland	2,000	247	
*Estabrook G. Dredging Co.	4, 5, 29, 33	36 N. 37 N.	7 W. 7 W.	Estabrook Gold Dredging Company, Trinity Center		2,814	R. XIV, pp. 918-19; XVIII, pp. 258, 297, 601, 735-36; Bull. 36, p. 104; U. S. G. S. Bull. 540, p. 19.
*Evans Bar	32	33 N.	10 W.	Carr Brothers	1,800	70	R. X, p. 707; XIII, p. 416; XIV, p. 905.
Fisher Gulch	1 36	34 N. 35 N.	11 W. 11 W.	P. H. Jensen, Junction City		160	R. XI, p. 483.
*Freethy	28, 29	36 N.	7 W.	W. F. Detert, 995 Market St., San Francisco		170	
*Lawrence Gardella	3	33 N.	9 W.	Lawrence Gardella, Redding		419	R. XVIII, pp. 42, 297, 497, 601, 734; Pre. Rep. No. 18, p. 18.
Garden Gulch	1, 12, 36	33 N. 34 N.	10 W. 10 W.	Mrs. M. L. Woodbury, Weaverville	2,200	86	R. XIV, p. 905.
*Gem Placer	13	6 N.	5 E.	Gus Perigot, Blue Lake		160	R. XIV, p. 905.
*Gilzean Group	18	33 N.	10 W.	C. C. Gilzean, Douglas City; J. A. Gilzean, Junction City		70	

*Golden Eagle	28	36 N.	7 W.	Trinity Dredging and Hydraulic Mining Company, 719 Pacific Bldg., San Francisco		120	
Gold Dollar No. 1-5 etc.	19, 24	34 N.	11 W.	Mary O'Neill, Weaverville; W. A. Day et al., Weaverville		146	
*Gold Dollar	33	33 N.	9 W.	Last Chance Mining Company	1,900	50	R. XIV, p. 906.
Gold Ridge	1 36	33 N. 34 N.	10 W. 10 W.	Estate of W. H. Martin, J. W. Tinnin, c/o M. Martin, Weaverville		35	
Good Friday and Red Sunday	19, 20	33 N.	10 W.	Estate of T. C. Post	1,700	110	R. X, p. 708; XII, p. 311; XIII, p. 447; XIV, p. 912.
*Graf Group	13, 18 et al.	35 N. 33 N.	11 W. 10 W.	R. J. Graf, 318 Fifth St., Eureka	1,600	798	I. X, p. 704; XII, p. 308; XIII, p. 443 (Compagnie Francaise).
*Graves	29, 30	37 N.	7 W.	Trinity Exploration Company, Carrville		350	R. XIV, p. 917.
*Gribble Group	8, 9 et al.	33 N. 34 N.	10 W. 11 W.	Richard Gribble, Junction City	1,700	282	R. XII, p. 311; XIII, p. 448.
*Hager and Haas	7, 18 12	33 N. 33 N.	10 W. 11 W.	Abrahm, Karsky and C. H. Edwards, Weaverville	1,600	291	
*Hammer Group				See South Fork.			
Hang Bar	36	31 N.	11 W.		2,400	40	R. X V, p. 906.
E. E. Hansen	29, 32 19, 34	34 N. 34 N.	9 W. 9 W.	M. Zanovich	2,400	209	R. XIII, p. 448.
Happy Home	30	35 N.	10 W.	Cons. with Dannenbrink	2,400	50	R. XIV, p. 906.
Harold Mg. and Dev. Co'sGrp.	25, 26 34, 35	35 N. 35 N.	8 W. 8 W.	Harold Mining and Developing Company, c/o G. O. Hunter, 331 Douglas Bldg., Los Angeles		390	
*Harmon and Allen	11, 13	33 N.	10 W.	J. W., A. C. and Louisa Meckel, Weaverville		180	
Harrison Gulch Mg. Co.	28 7, 8	30 N. 29 N.	10 W. 10 W.	Harrison Gulch Mining Company, c/o A. P. Stice, Red Bluff		280	
Haskins	5	36 N.	7 W	F. Petra	2,400	129	R. X, pp. 698-99; XIII, pp. 448-49; XIV, p. 906.
Haunted Bar				J. L. Mushick		100	R. XIV, p. 917.
Hawk Eye		35 N.	11 W.	A. H. Wolfe and Mrs. G. M. Todd, 57 Soquel Ave., Santa Cruz		40	
*Hawkins Bar	20, 21, 28	6 N.	6 E.	Eleanore I. Brizzard, Burnt Ranch	900	338	R. XIII, p. 449; XIV, p. 907.
*Hazel G. Mg. Co.	14	32 N.	8 W.	Hazel G. Mining Company, Room 507, 525 Market St., San Francisco		320	
Henderson	13	6 N.	5 E.	Henderson & Ferguson		60	R. XIV, p. 907.
Hidden Treasure				J. B. McDonald		60	R. XIII, p. 449; XIV, p. 917.
*Highland Mg. Co.	25	5 N.	7 E.	Highland Mining Company and D. B. Lyon, c/o A. B. Champlin, Red Bluff		40	

---

*Indicates property patented or surveyed for patent, according to county records.

[1] Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			[1] Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
*Hiliard and Daisy	13, 24	31 N.	12 W.	George Van Gordan	2,300	315	
*Hill Crest	17	33 N.	10 W.	A. A. and F. A. Schaffer, Junction City		40	
*Hindley	5, 6	33 N.	9 W.	Clara H. Godfrey, Weaverville, and Maud W. Hupp, 12 Hill Crest Court, Berkeley		54	
*Hocker	1, 2	33 N.	11 W.	Jos. M. Hocker et al., 110 Nineteenth Ave., San Francisco	1,600	56	
Hodges Group	12	38 N.	9 W.	W. L. Hodges, Coffee		120	
*Hook and Ladder	5, 6	33 N.	9 W.	W. H. LaBaree, 2201 Glen Ave., Berkeley; L. H. Brady, Weaverville, et al.	2,300	105	R. XIV, p. 907
Harvey Cons.	7, 8	33 N.	9 W.				
Horseshoe Bend				See Swanson Group.			
Horseshoe and Homestake	18	33 N.	9 W.	Wm. B. Testy, 729 Main St., Vallejo; C. J. Testy, Weaverville		130	R. XIV, p. 907.
Howard and Campbell	5	33 N.	12 W.	S. M. Campbell, R. D. Howard, Big Bar		35	
Humboldt Co's Group	5, 6, et al.	34 N. 34 N.	8 W. 9 W.	Humboldt Placer Mining Company, c/o M. J. Curless, Blocksburg	2,600	4,805	R. XIV, p. 912.
*Hydraulic Hill	32	34 N.	11 W.	The Lorenz Company, c/o E. H. Moody, Redding		38	R. XIV, p. 907.
Indian Creek	23, 26	32 N.	9 W.	Dr. D. B. Fields, Weaverville	2,100	1,744	R. XIV, p. 907.
Panwocket	27, 28	32 N.	9 W.				
Indian Creek	5, 8	32 N.	9 W.	Manuel C. De Reis, Douglas City		30	
Ingleside	27, 28	35 N.	8 W.	G. A. Steward	2,300	60	R. XIII, p. 450
Ivy Gulch	3	33 N.	12 W.	Mrs. Julia Ivy, Helena	1,275	20	
Jack Tar	2	33 N.	10 W.	Edw. Meekel and John Haley, Weaverville		40	
*Jacob			---	See Barthol Jacob.			
Jennings Gulch			---	Jennings Gulch Mining Company			R. XVIII, p. 450; Bull. 92, p. 95.
Joss	7, 18	33 N.	9 W.	H. S. Lowden, Weaverville	2,200	139	R. XIV, p. 908.
*Johnson Point	4	32 N.	10 W.	Geo. F. Lewman, Junction City	1,600	20	
Joy Group	1, 12, 31	30 N. 31 N.	10 W. 9 W.	Russell T. Joy, 604 Mission St., San Francisco		217	
*Just in Time				See Democrat Gulch.			
Katie Foley Group	10	37 N.	7 W.	F. C. Potter, F. O. Harris, J. J. Dean, F. J. Campbell, A. L. Harrington, Jas. Goodyear, c/o Harrington, 308 Montgomery St., San Francisco		51	
Keystone Group				C. A. Austin, Denny		120	R. XIII, p. 452.
King Hydraulic				H. King et al., Big Bar			R. XIV, p. 908.

Kingsbury				Tom Collins, Hayfork			
Koon	23, 24, 25, 26	6 N.	5 E.	John A. and Myrtle H. Koon, Salyer		200	Bull. 85, p. 88.
*La Grange Mining Co.	3, 4, 9, 10, 11, 15, 22	33 N. 34 N.	10 W.	LaGrange Mining Company, Weaverville; c/o B. R. Brown, Weaverville; L. A. Dru, 233 Broadway, New York		5,006	R. VIII, p. 638; X, p. 702; XII, p. 311; XIII, pp. 452-53; XIV, p. 908; XVIII, p. 908; XX, p. 182; Bull. 92, p. 94.
Ladd Group		7 N.	7 E.	Grover H. and W. Ladd, Denny		60	
Larsen				Larsen Brothers		40	R. XIV, p. 909.
Last Chance et al.				See Montezuma.			
Laws	13, 18	33 N.	10 W. 11 W.	Lena A. Bergin, Round Mountain, Nevada	1,600	30	
Leas Group		33 N.	8 W.	J. C. Leas, Lewiston		80	
*Lewiston Gold Dredging Co.	21, 22 et al.	34 N.	8 W.	Lewiston Gold Dredging Co., Lewiston		405	R. XVIII, pp. 139, 297, 601, 733; Bull. 92, p. 94; Pre. Rep. No. 8, p. 18.
Linda Marie	32, 33	1 S.	8 E.	C. H. Mathews, Forest Glen		100	R. XVIII, p. 543.
Lister Group	17	33 N.	8 W.	H. B. Lister, L. M. Lister, 805 Pacific Bldg., San Francisco		47	
Little Creek	31	32 N.	12 W.	Asa Drake, Hayfork		20	
*Little Joe	25	32 N.	9 W.	Est. of F. R. Duarte; E. L. Rogers, Douglas City		40	R. XIV, p. 909.
Log Cabin	33	32 N.	9 W.	Wm. O. Wallace, Douglas City		120	
Log Cabin Bar		7 N.	7 E.	F. Staley		40	R. XIV, p. 909.
Long	13	33 N.	10 W.	W. W. Armentrout, Weaverville		20	
Long Gulch	17	35 N.	8 W.	F. Beaudry Estate	2,600	120	R. XIV, p. 909.
*Lorenz Group	18, 19 13	33 N. 33 N.	9 W. 10 W.	W. D. and G. C. Lorenz, Weaverville	2,500	303	R. XVIII, pp. 97, 207, 257; XIX, p. 139; XX, p. 182; Pre. Rep. No. 8, p. 17; Bull. 92, p. 94-95.
Lower Buckeye	19, 30 29	37 N. 37 N.	7 W. 7 W.	Trinity Gold Mining Company	2,500	140	R. XIV, p. 909.
Lower Dutton's Creek	26, 35	33 N.	10 W.	J. N., W. D., G. C., F. J. Lorenz and Estate of Henry Lorenz, Weaverville	1,700	78	R. XIV, p. 909.
Lucky Mack Group				See Bower and Matlock.			
Lucky Strike and Effie Belle	13, 24 14, 23	33 N. 33 N.	10 W. 10 W.	See Democrat Gulch	2,200	780	R. XIV, p. 910; XVII, p. 543.
Lucky Strike				C. Schwelder		60	R. XIV, p. 917
Mahoney and Wallace					1,750		R. XII, p. 312; XIII, p. 455
Manuel and Santos	19	33 N.	8 W.	C. H. Edwards, Weaverville; Estates of N. G. and J. D. Day, Weaverville		10	

---

*Indicates property patented or surveyed for patent, according to county records.

[1] Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			[1] Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Maple Creek	1, 5, 6 et al.	32 N.	10 W.	Maple Creek Mining Company, San Francisco	2,000	1,594	R. XIV, p. 1910.
Martin Group	21, 30	31 N.	9 W.	Estate of W. H. Martin, Sr., c/o M. Martin, Weaverville		59	
McAtee Bar		7 N.	7 E.	C. S. McAtee		60	R. XIV, p. 910; Bull. 92, p. 93.
McDonald		--		Estabrook Gold Dredging Company, Trinity Center			R. XVII, p. 513.
McGillivary et al.	26, 27, 31, 35	34 N. 34 N.	11 E. 11 E.	W. H. Metson, G. O'Shay et al., c/o G. O'Shay, Junction City	1,750	1,107	R. X, p. 706; XIII, p. 455.
McIlwaine Claims	16, 22 27	38 N. 38 N.	9 W. 9 W.	M. H. McIlwaine, Carrville		180	
*McMurry and Hupp	7	33 N.	9 W.	Trinity Consolidated Hydraulic Mining Company, L. H. Brady, Weaverville	2,200	60	R. VIII, p. 638; X, p. 701; XII, p. 312; XIII, p. 455; XIV, p. 915
Meckel	13, 14	33 N.	10 W.	J. W., A. C. and Louisa Meckel, Weaverville	2,600	150	R. XIV, p. 910
Mike Smith	19, 30	33 N.	9 W.	W. H. Leach, Weaverville		17	
*Mineret	2	33 N.	10 W.	H. D. Weinheimer, Weaverville		10	
Minersville	22, 27	35 N.	8 W.		2,375	160	R. XII, p. 312, XIII, p. 455.
Monk	5	32 N.	9 W.	W. Brannan	1,650	30	R. XIV, p. 910.
Monte Christo and Apple Tree	1	31 N.	11 W.	Manuel Machado, Dedrick		30	
*Montezuma et al.	1, 2, 11, 12	33 N. 33 N.	11 W. 11 W.	W. H. Metson, J. S. Sullivan, et al., c/o G. O'Shay, Junction City	1,600	531	R. XIV, p. 911
Morris Group	19 21	1 N. 1 N.	7 E. 6 E.	H. W. Brannan et al., Burnt Ranch			
*Morrison Gulch	12, 13 14	37 N. 37 N.	8 W. 8 W.	New Blue Jay Mining Company, 3320 Geary St., San Francisco	3,000	76	R. XIV, p. 910.
Morris, Wm.	25	32 N.	9 W.	William Morris et al.		80	R. XIV, p. 916.
Mouth of Weaver	6	32 N.	9 W.	I. T. and L. W. Cruthis, Douglas City		30	
*Nash Deep Gravel G. Mg. Cons.	6, 7 18, 27 28, 29 30, 31	37 N. 38 N.	9 W. 9 W.	Nash Deep Gravel Gold Mining Cons., c/o J. L. Joseph, 542 Mills Bldg., San Francisco	5,000	866	R. XIII, pp. 464-65; XIV, p. 911; XVIII, p. 6; Bull. 92, p. 95
Negunda	12	6 N.	5 E.	H. Zeigler			R. XIV, p. 917.
*Nellie May	5, 6	33 N.	12 W.	Thos. Treloar, Big Bar		20	
New Discovery	16	33 N.	10 W.	A. A. and F. A. Schaffer, Junction City		143	

New River	13	6 N.	5 E.	Ladd Brothers, Denny	1,650	130	R. XIV, p. 911; Bull. 92, p. 93
Nigger Hill	2	32 N.	10 W.	G. Lewman	1,700	40	R. XIV, p. 911.
Nugget Bar	22, 27	35 N.	8 W.	Van Matre heirs (owners) Nugget Bar Placer Company, Oakland (lessee)	2,200	610	R. XVIII, p. 496; XIX, p. 110; XX, p. 182.
	4, 5	34 N.	8 W.				
*O'Connell	33	32 N.	9 W.	William O. Wallace, Douglas City		101	R. XIV, p. 911.
O'Neill Group	11, 12	33 N.	10 W.				
	2	33 N.	10 W.	Sam Lee, Weaverville		100	
Oregon Gulch	7, 8	33 N.	10 W.	Richard Gribble, Junction City		77	
*O'Shay Group	2, 35	33 N.	11 W.	W. H. Metson, Estate of Mary O'Shay, J. S. Sullivan, c/o G. O'Shay, Junction City		1,636	
	et al.	34 N.	10 W.				
Pacific Gold Dredging Co.				Pacific Gold Dredging Company, Carrville			R. XVIII, p. 258; Pre. Rep. No. 8, p. 18.
Paso Rico		35 N.	11 W.	A. H. Wolfe, Helena		73	
Patrick Holland	16, 17	38 N.	8 W.	Patrick Holland, 227 N. D St., San Mateo	4,000	110	
Paulson Hyd.				See Pickett and Stofer P. M.			
Paulson and Hughes							R. XII, p. 313; XIII, p. 459
Pelletreau Group	8	34 N.	11 W.	Alex Pelletreau, Helena		40	
Perry Group	1, 30	33 N.	11 W.	I. W. Perry et al., c/o Raymond Perry, Mills Bldg., San Francisco		56	
	12	35 N.	11 W.				
*Phillips	20	33 N.	8 W.	Estates of Lucy F. and Chas. A. Phillips, c/o J. W. Phillips, Lewiston		53	R. XIII, p. 459.
Pickett and Stofer	5, 6	33 N.	8 W.	Chas., H. W., F. R. and A. E. Paulson, Lewiston	2,000	114	R. XVIII, pp. 97; 257; XIX, p. 139.
	36	34 N.	8 W.				
Pine Tree	30	32 N.	8 W.	Frank L. Upham, Douglas City		40	
Pittsburg Comstock				See Danenbrink			
*Plummer Gulch, Nelson Gulch	11, 12	36 N.	7 W.	M. H. McIlwaine and C. B. Kingsbury, Trinity Center		200	
*Poker Bar Mines Co.	24	33 N.	9 W.	Poker Bar Mines Co., 353 Mills Bldg., San Francisco		80	
Pony Bar	20, 28	6 N.	6 E.				
	29	6 N.	6 E.	James J. Irving, Salyer		60	
Post and Wilson	19, 20	33 N.	11 W.	See Good Friday.			
Potillo	14	33 N.	10 W.	F. Potillo	2,300	30	R. XIV, p. 911.
Poverty Flat	18, 19	33 N.	9 W.	Lorenz Brothers	2,000	30	R. XIV, p. 912.
Precious Twins	17	4 N.	6 E.	Frank Lynch, Hyampom		200	R. XIX, p. 94
*Price	1, 5	33 N.	12 W.	George W. Tinsley, Big Bar	1,360	20	R. X, p. 709, XIII, p. 460
Prussian and Heimburger	12	34 N.	11 W.	J. A. Burger and Lewis Heimburger, Junction City		58	
Quimby	18	6 N.	6 E.	Ferguson and Ziegler		100	R. XIII, p. 460; XIV, p. 912

---

*Indicates property patented or surveyed for patent, according to county records.

[1] Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			[1] Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
*Railroad and Mr. Morensis	9, 15 16	33 N. 33 N.	10 W. 10 W.	A. A. and F. A. Schaffer, Junction City	3,000		R. X, p. 704; XIII, p. 154; XIV, p. 912.
Rainbow	33	28 N.	8 W.	Rainbow Mining Company, Carrville		60	R. XIII, p. 460; XIV, p. 917-18
Red Bank and Banon	7	31 N.	11 W.	Thos. Collins, Hayfork		40	
*Red Flat	12	34 N.	11 W.	Cons. with Danenbrink	2,100	55	R. XIV, p. 912.
*Roe	1, 6 31	32 N. 33 N.	9 W. 10 W.	Trinity Consolidated Hydraulic Mining Company	1,700	36	R. XIV, pp. 912-13.
Ruby and Spanish Mike	2	33 N.	10 W.	B. R. Brown and Paul Potillo, Weaverville		89	
St. Marys and Live Oak	21	37 N.	8 W.	J. L. Morrison, Estate of John Larson, Trinity Center		10	
*Salt Flat	21, 13 23	33 N. 33 N.	9 W. 9 W.	Pacifico Fancelli, 743 Howard St., San Francisco		230	
Sam Hampton	16, 17	35 N.	8 W.	C. E. Wright	2,400	80	R. XIV, p. 918.
Schlomberger	13	38 N.	9 W.	Frank Schlomberger, Coffee		80	
*Schlomer and Meckel	29, 28	34 N.	11 W.	H. G. Louisa and Estate of C. C. Schlomer, Helena		100	R. XIV, p. 913.
Senger	12, 13	33 N.	10 W.	J. Senger	2,100	60	R. XIV, p. 913.
*Sheridan	18, 19	33 N.	10 W.	W. J. Dyman	1,700	104	R. X, p. 703; XII, p. 313; XIII, p. 462; XIV, p. 913.
Siegfield	25	32 N.	9 W.	E. L. Rogers et al., Douglas City			
Slate Creek	2, 3	34 N.	9 W.	F. Cadematori	2,700	120	R. XIV, p. 913.
*Smith Creek and Gibson	14	32 N.	10 W.	R. K. and W. S. Gibson, Weaverville		190	
Smith Group	30	35 N	10 W.	Peter D. Smith, Dedrick		35	
Snow Gulch	21, 28	37 N.	7 W.	R. G. Abrams et al., Trinity Center		560	R. XIV, p. 918.
South Fork	22, 23 14, 15	6 N. 6 N.	5 E. 5 E.	South Fork Gold and Platinum Mining Company, P. P. Hammer, Salyer	660	895	R. XII, p. 133; XIII, p. 463; XIV, p. 913; Bull. 85, pp. 86-88
Sowden	2	33 N.	10 W.		2,200	10	R. XIII, p. 463; XIV, p. 913
Steiner's Flat	35, 36	33 N.	10 W.	W. D. and G. C. Lorenz, Weaverville		160	R. XIV, p. 914.
*Stella No. 3	19, 30	33 N.	9 W.	St. George Hotel Co., Fourth and J Sts., Sacramento		80	
Stevens Gulch		38 N.	9 W.	George Zinn, Coffee			R. XVII, p. 543.
Stick to it	8	37 N.	7 W.	Ada G. McDevitt, Carrville		5	
Stiller	22, 10 4	35 N. 35 N.	8 W. 8 W.	J. A. Stiller, Minersville or Redding	2,600	360	

*Sturdivant et al.	7, 8, 9	33 N.	10 W.	Richard Gribble, Junction City	1,600	282	R. XIV, p. 914.
Swanson Group	20	6 N.	6 E.	Nels Swanson, Burnt Ranch		120	
Tanner Group	28	34 N.	8 W.	Mabel A. Tanner, 529 W. Doran St., Glendale		185	
*Teal and Perigot	18	6 N.	6 E.	Gus Perigot and Geo. F. Teal, Blue Lake		230	R. XIV, p. 905; Bull. 85, p. 89.
*Ten Cent	6 31	33 N. 34 N.	9 W. 9 W.	M. L. Woodbury, Weaverville; Nellie L. Wallace, 1006 Page St., San Francisco	2,400	80	R. XIV, p. 914.
Tenner	30	8 N.	8 E.	W. L. and R. W. Tener		240	R. XIV, p. 914
Texas Bar	6	32 N.	9 W.	G. Vitzhum	1,800	50	R. XIV, p. 914.
Timmerman and McKenzie	2, 11	33 N.	10 W.	John I. Adams, Weaverville	2,200	135	
T. and O.	12	33 N.	10 W.	P. J. McCarthy and Leo Huebner, Box 231, Susanville		48	
Tinsley and Treloar	5	33 N.	12 W.	G. W. Tinsley and E. W. Treloar, Big Bar		240	
Tolly Hill	34	35 N.	9 W.	J. H. Cummings	2,500	160	R. XIV, p. 914
*Tom Bell	5, 6	33 N.	9 W.	E. C., B., E. V. and K. V. B. Young, Weaverville	2,200	40	R. XVII, p. 543.
Top Notch	12, 13	6 N.	5 E.	F. Renney, Salyer P. O.			R. XIV, p. 915; Bull. 85, p. 89.
*Trinity Cons. Hyd. Mg. Co.	8, 34 et al.	33 N. 32 N.	9 W. 10 W.	Trinity Cons. Hyd. Mining Company		1,720	R. XIV, p. 915.
*Trinity Dev. Co.	7, 8 et al.	37 N.	7 W.	Trinity Development Company, Inc., Holbrook Bldg., 58 Sutter St., San Francisco		670	
*Trinity Gold Dredging Co.	5, 6, 7 et al.	33 N. 34 N.	8 W. 8 W.	Trinity Gold Dredging Company, Lewiston		671	R. XIV, p. 919; XVIII, pp. 601, 734-35; Bull. 36, p. 104; Bull. 92, p. 95; U. S. G. S. Bull. 540, p. 20; Pre. Rep. No. 8, p. 18.
Trinity River Mining Co.	5, 8	33 N.	8 W.	Trinity River Mining Company, 193 Twelfth St., Oakland		341	R. X, p. 709; XII, p. 314; XIII, p. 465; XIV, pp. 915-16; U. S. G. S. Bull. 540, p. 20.
*Two Sisters and Wonder	25	35 N.	8 W.	Lillian N. Hassman, 2201 P St., Sacramento		80	
Tyson	30	35 N.	10 W.	C. H. Edwards, Weaverville		38	
*Union Gulch	9	33 N.	9 W.	W. Herbert Samson, Corning		80	
Union Hill Hydraulic	6	32 N.	9 W.	Trinity Consolidated Hydraulic Mining Company	1,800	300	R. XII, p. 314; XIII, p. 465; XIV, p. 915; XVIII, pp. 97, 207; XIX, p. 58; Bull. 92, p. 94.
Unity Hyd.				See Nugget Bar and Van Matre.			
Upper Dutton Creek	26	33 N.	10 W.	The Lorenz Co., c/o Mrs. E. H. Moody, Redding, and Trinity Consolidated Hydraulic Mining Company		72	

---

*Indicates property patented or surveyed for patent, according to county records.

[1] Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			[1] Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Valdor	1, 2 et al.	33 N. 34 N.	11 W. 11 W.	Valdor Dredging Company, c/o G. A. Hutton, 582 Market St., San Francisco		845	R. XIV, p. 916.
Van Matre Group	22, 27 4, 5	35 N. 34 N.	8 W. 8 W.	Bertha L., E. A., G. L., W. J. and J. C. Van Matre, Loda Foster and Irene M. Vollmers, and Edna M. Browning, Minersville		800	R. XVIII, p. 196; XIX, p. 146; XX, p. 182.
Wallace Group	13, 11 et al.	32 N. 32 N.	9 W. 9 W.	W. O., L. S. and David Wallace, Douglas City		112	
*Ward	10, 11	33 N.	10 W.	Mary E. and Robert Ward and Alice J. Wain, 92 Empire St., Lynn, Massachusetts	2,900	160	R. XIII, p. 638; X, p. 696; XI, p. 484.
Watson Bar	23	5 N.	7 E.	G. W. Pelletreau, Big Bar	1,190	20	R. XIII, p. 466.
Weaver Creek	19, 30	33 N.	9 W.	W. A. Brady, Weaverville		140	
Wheaton and Stuart	8, 9	33 N.	10 W.	Richard Gribble, Junction City		52	
*Whitmore Gold	10	33 N.	10 W.	Estate of Jane Gribble, c/o Richard Gribble, Junction City	1,600	44	
*Wild Cat	34	35 N.	9 W.	J. H. Cummings and C. L. Cummings, Weaverville		160	
Wilker	5	39 N.	7 E.	J. E. Crawford		160	R. XIV, p. 918.
Woodbury	35	31 N.	11 W.		2,200	40	R. XIV, p. 916.
*Woodbury	36	31 N.	10 W.	Frank L. Woodbury, Weaverville		30	

*Indicates property patented or surveyed for patent, according to county records.

[1] Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

The mine is at an elevation of 1800 to 2000 feet and aneroid readings indicate that the present bank is 140 feet high. The bedrock is greyish green to black mica schist. Next to it lies a bed of coarse blue gravel, covered by black, peaty clay and partly formed lignite, then fine sediments. The pay is said to be confined to about 10 feet of blue gravel next to bedrock. The balance of bank is red and yellow clayey sediment, unstratified but carrying fine, angular gravel. The pit, perhaps 10 acres in area, is completely covered, except for about one acre, to one-half the height of the bank, with caved ground (see photo) which is moving toward the outlet, and this is hampering operation. The lower layer of pay gravel is said to be rich enough to make operation profitable when bedrock can be reached.

The geology of the mine was covered in detail in United States Geological Survey Bulletins 430, 470 and 540.

Union Hill Hydraulic Mine, near Douglas City, showing pit and caved bank.

GOLD DREDGING.

The gold dredging operations in Trinity County were described by W. B. Tucker[1] in the December, 1922, issue of MINING IN CALIFORNIA. As there have been few changes in the dredging situation since then, the writer is referred to the above chapter, which is still available at the bureau's offices for free distribution, and only a few notes are added here. Reference to the accompanying tabulation of properties will give the acreage of land now held by dredging operators in the county. Dredgers now produce most of the gold from the county.

Estabrook Gold Dredging Company's operations have proved very profitable at times during the past year and a half. During the past summer they were hydraulicking overburden from ground 125 feet deep, preparatory to dredging. They were dredging ground 34 feet deep of which the lower 10 or 12 feet is cemented. Their dredger is the largest wooden hull dredger in the world.

---

[1] Mining Engineer, State Mining Bureau, formerly in charge of Redding office.

Gardella dredger is reported to have burned late in 1925.

Trinity Gold Dredging Company is at present building a new dredger on Blakemore Ranch four miles above Lewiston. It is anticipated that it will be ready for operation by April, 1926. Their old boat had been in use 12 years.

Upstream on Trinity River above the present holdings of the Estabrook Company, Pacific Gold Dredging Company operated a dredger for some time near Carrville and drilled additional ground near that village that was not worked. The dredger was dismantled in 1922 and shipped to the Federated Malay States. The company had previously attempted to operate the same dredger on Coffee Creek above Carrville, but had been forced to quit because of the heavy boulders, although considerable gold was reported on bedrock. In some places along Trinity River bedrock is hard and the cost of replacing worn and broken parts is reported high.

Other areas that have been drilled are the Hayfork Valley, containing about 10,000 acres, of which two-thirds are gravel, and some small areas on Trinity River near the mouth of the South Fork, as well as above Junction City. The Valdor dredger, from which the machinery of the present Lewiston Gold Dredging Company's dredger came, was operated on Trinity River five miles below Junction City on gravel averaging 24 feet deep, embracing old placer diggings on limestone and serpentine bedrock.

Bibl: Cal. State Min. Bur. R. XIV, p. 918; R. XVIII, pp. 733–736 (Mining in California, Monthly, Dec. 1922, pp. 733–736). Bull. 85, pp. 84–85.

GRANITE.

A little granodiorite has been quarried on Rush Creek, six miles east of Weaverville, for local use for monuments and buildings.

LIMESTONE and MARBLE.

Limestone and marble are common in the county, but have been developed very little on account of distance from markets. It occurs in both the so-called 'Pre-Cambrian Metamorphics' and in rocks of known Devonian age. Local use has been made in Weaverville of limestone quarried on Brown's Mountain in Sec. 21, T. 33 N., R. 9 W., and in Sec. 3, T. 33 N., R. 10 W. This was burned in small kilns, but there has been no recent production. The remoteness of the county, and small local population, preclude the development of deposits.

Bibl: Cal. State Min. Bur. Bull. 38, p. 94. R. XIV, p. 920. Diller, J. S., Amer. Journal of Science, 4th Series, Vol. 15, p. 342.

MANGANESE.

Manganese oxide ore occurs in the region of the headwaters of the South Fork and Hayfork of Trinity River, and in the southwestern part of the county, and in the southern part near the Mendocino County line. The last two areas are in the Franciscan rocks, and the deposits are similar geologically to those worked elsewhere in the Coast Ranges. Possibly other deposits might have been developed had the war continued, but work stopped when high war-time prices fell.

The *Caudwell Prospect* in N½ of Sec. 21, T. 28 N., R. 11 W., the *Johnson Prospect* in Secs. 9 and 10, T. 28 N., R. 11 W., and *Selvester* and *Wilson Prospect* in SE¼ of Sec. 34, T. 29 N., R. 11 W., and other prospects, lie at elevations of from 4000 to 5000 feet, on the divide at the headwaters of South Fork and Hayfork of Trinity River, 70 to 72 miles from Redding, the nearest railroad shipping point, and 14 miles of this is trail from Wildwood. The first named was a promising showing but undeveloped. The second was prospected and some ore mined, but not shipped.

Naphis Peak Mine is three miles northeast of Kekawaka Siding on the Northwestern Pacific Railroad. It produced a few carloads of ore in 1916 and 1917.

Red Cliff Prospect is in Sec. 36, T. 25 N., R. 13 W., near the southern county line.

McKnight and *Kindred* deposit is 3½ miles northeast of Jewett Siding on the Northwestern Pacific Railroad. Low grade ore was developed.

Bibl: Cal. State Min. Bur. Bull. 76, pp. 90–91.

MINERAL PAINT.

Red ocher occurs in Sec. 15, T. 35 N., R. 8 W., on the east side of East Fork of Stuarts Fork; and in Sec. 9, T. 35 N., R. 8 W.

Bibl: Cal. State Min. Bur. Bull. 38, p. 342.

MINERAL WATER.

Deer Lick Springs. Owners, California Medicinal Springs, care H. R. Given, Weaverville. The property contains 106 acres, patented, in Secs. 6 and 7, T. 30 N., R. 9 W., near the eastern county line, and is reached by trail only. Elevation is 3000 feet.

These springs have enjoyed for many years a local reputation for efficacy in the treatment of blood diseases, and many stories are told of remarkable results had in cases where sick people have camped at the springs for a short time and used the water daily. The water was placed on the market several years ago under the name "Nipicuro," but there has been no recent output. There are few improvements and no buildings for the accommodation of guests, and visitors bring their own outfits. The springs are 28 miles by road and trail south of Weaverville or nine miles by trail from Knob, Shasta County.

There are five springs in the group, giving a total flow of about eight gallons per minute of cold water, which is highly sulphuretted and contains also quite a large amount of calcium, sodium and the chloride radical. The springs are described in detail, with analyses, in U. S. Geological Survey Water Supply Paper 338, pp. 261–263.

Other sulphur springs have been noted along Browns Creek, one mile and more downstream from Deer Lick Springs, but these have never been improved or utilized.

MOLYBDENUM.

Molybdenum occurs on Grass Valley Creek, four miles from Lowdens Ranch. The location is given as Sec. 31, T. 33 N., R. 8 W. and molybdenite and molybdite are reported. Molybdenite has also been mentioned as occurring near Helena. Both showings are believed to be small, and are undeveloped.

Bibl: Cal. State Min. Bur. Bull. 91, p. 32.

PLATINUM GROUP METALS.

Metals of this group have been found in various parts of the county, particularly in gravel on the benches and bars of Trinity River from Dutch Creek, above Junction City, for several miles downstream; in New River district; on Hayfork Creek, and on the main river and its south fork in the area adjacent to their junction. So far, the metals have been found only associated with gold in the gravel deposits, and have not yet been found in place. In 1917, the writer covered the subject for the State Mining Bureau in cooperation with geologists of the United States Geological Survey, and the results of this field work were published as Bulletin 85 of the State Mining Bureau. At that time claims were being made that prospects of platinum in veins had been found in the vicinity of Soldier Creek and nearby, upstream from Junction City, and the party covered the district in detail but were unable to find anything to substantiate the reports.

The hydraulic mines a short distance upstream from Junction City, particularly the old Chapman and Fisher Mine, produced numerous nuggets of platinum metals up to one ounce each in weight. The wash in these mines, between Dutch Creek and the Jacob Mine is characterized by enormous boulders, which are not seen in the river gravel above Dutch Creek. The platinum metals also disappear at the same place, and no record could be found of platinum production farther upstream on Trinity River, although two dredgers were then operating, one near Lewiston and one near Trinity Center. Neither is there any record of the production of platinum from the La Grange Mine, a short distance east of Junction City on a Tertiary channel of Trinity River, where a very large yardage was handled and an efficient system of gold saving was in use. At the same time, platinum group metals were saved in some quantity at the Valdor dredge, which operated in the river five miles below Junction City.

The proportion of platinum metals to gold in these placers was small, although much higher than in Yuba County and elsewhere in the state. Over a period of several months, the ratio of platinum to gold (by value) was 1¼ to 100 on the Valdor dredge. The platinum metals were recovered principally by hand panning of the long tom concentrate, which was the product obtained by running the black sand from the dredger through a long tom several times. The platinum group metals occur in this district as fine flakes (probably composed chiefly of platinum) and as crystalline, sharp-edged pieces and nuggets up to an ounce in weight. The angular pieces and the nuggets are a native alloy of osmium and iridium as well as platinum, and for this reason the term 'platinum group metals' is the only accurately descriptive one available. Osmiridium and platiniridium are much harder than platinum and less easily soluble. While platinum has a hardness of only 4 to 4.5 and is so malleable as to be hammered into flakes in the streams, the alloys named have a hardness of 6 to 7, are too hard to be scratched by a knife, and retain their crystal form and brilliant metallic luster on the clean cleavage faces. Osmiridium is chiefly valuable for its iridium content, which is much in demand for manufacturing standard weights and measures, fine tools, knife edges in sensitive balances, and tips for fountain pens. 'Hard platinum,' containing 90% platinum and 10% iridium, is much used in electrical equipment, such as contact points on magnetos. Analyses of platinum group metals recovered on the Valdor dredge in 1917 indicated 40% to 43% platinum, and 47% to 58% osmiridium. This dredge was dismantled and moved to the Lewiston district late in 1922. Since then the platinum production of the district has practically ceased.

In the other districts mentioned in this county as producing platinum the mode of occurrence is similar to that near Junction City, the few ounces produced annually being a by-product of a few small hydraulic mining operations. The region near the mouth of the South Fork of Trinity River is now the most interesting in the county from the standpoint of platinum metal possibilities. There are hydraulic mines there which, while yielding a satisfactory gold output, appear to carry a higher ratio of platinum group metals than other properties. These mines have so far been operated only on a small scale due to scarcity of water. Among them may be named the Hammer Group, Oro Corono and Teal and Perigot, described under placer mines herein. No analyses are available for this district, but the platinum metals appear to be similar in content to those near Junction City. The output of these metals for the entire county was only 11 ounces in 1924.

QUICKSILVER.

Quicksilver was produced in the Altoona district prior to 1875, by washing gravel containing cinnabar which came from erosion of the veins. The Altoona Mine prior to 1875 is estimated to have produced 1000 flasks[1] of mercury, and since that year this property is said to have produced about 28,000 flasks of a total of a little over 31,000 flasks credited to the county. There has been no production for three years past.

The productive area is in the northeastern part of the county in sections 15, 22 and 23, T. 38 N., R. 6 W., and is reached by the Ramshorn road running west from Castella. Other prospects have been noted in the vicinity of Carrville, in New River district, and near Canyon Creek, south of Dedrick.

Altoona Quicksilver Mine. Owner, Altoona Quicksilver Mining Company, 216 Pine Street, San Francisco. It includes three patented claims, Trinity, Altoona and Central, containing 54.6 acres, in Sec. 22, T. 38 N., R. 6 W., and 400 acres of other patented land in the N½ of Sec. 26, and NE¼ of Sec. 28, T. 38 N., R. 6 W. The Altoona and Boston ditches and water rights in Crows Creek and Wilts Ravine are also claimed. The elevation is 4625 feet and the property is reached by 20 miles of road (the Ramshorn grade) from Castella.

This area is mostly covered by serpentine, which contains chromite mines and asbestos prospects. The quicksilver occurs as cinnabar in an altered rock, apparently originally porphyry. The property has been described in numerous past publications, and the following paragraph is quoted from the latest of these.[1] There is nothing new to add to this, as later operations consisted in cleaning up on the surface.

---

[1] Cal. State Min. Bur. Rep. IV, p. 336.

"There are four veins, three coming together at the lowest level, forming a mineralized zone 400′ long, and from 4′ to 50′ wide. The ore appears to be a contact deposit between serpentine and 'porphyry.' The footwall is serpentine. The workings consist of a vertical shaft 450′ deep, with five levels. In the lowest level, a winze, 152 feet deep was sunk, from which two levels were driven. There are seven levels in all, covering a territory of 1600 feet in a northwest and 1120 feet in a northeast direction, within which four different veins were worked to a depth of 600 feet. The mine makes considerable water, and was shut down in 1902, when fire destroyed part of the reduction plant, which has since been repaired. The reduction plant includes a Knox & Osborne fine-ore furnace, and a retort. Water supply is obtained from Crow Creek, between the east and north forks of Trinity River. There is abundant pine and fir timber in the vicinity."

> Bibl: Cal. State Min. Bur., Reports IV, p. 336 (table); VIII, p. 643; X, p. 716; XI, pp. 481, 482; XII, p. 371; XIII, pp. 603–604; XIV, p. 923. Chapter rep. bien. period, 1913–1914, p. 179. Bull. 27, pp. 192, 219; Bull. 78, pp. 200–201. U. S. G. S., Mon. XIII, p. 366. Min. Res. W. of Rocky Mts., 1875, p. 20; 1876, p. 19.

Anna Bell Cinnabar Mine. Owner, John Burger, Junction City. It contains 40 acres, unpatented in Sec. 1, T. 34 N., R. 11 W., 2½ miles south of Dedrick. Assessment work only.

Carr Quicksilver prospect. One claim, in Sec. 22, T. 38 N., R. 6 W. Idle, and ownership unknown. A few open cuts run years ago showed some cinnabar. Adjoins Altoona Mine on the east.

> Bibl: Cal. State Min. Bur. Bull. 27, p. 193; R. XIV, p. 924.

Integral Quicksilver Mine. Owner of four-fifths interest, Wm. J. Simpson, 91 Park Row, New York. The holdings include the Integral Consolidated, Boston, Invincible and other patented claims, and a number of sections of timber land, a total of 2604 acres, in Secs. 14, 15, 21, 22, 23, and 27, T. 38 N., R. 6 W., reached by the Ramshorn road from Castella. The mine workings are near the corner common to sections 15, 22 and 23. The ore occurs in lenses in or at the contact of serpentine. According to Wm. Forstner,[2] "In this serpentine lies a body of highly altered rock, probably an altered feldspar porphyry, as far as ascertained, in the form of an irregular lens with a northwesterly dip. In the parts of the lens which carry ores the material is thoroughly decomposed by the action of the mineral-bearing waters which deposited therein iron and mercury sulphides, the former being largely, if not entirely, weathered into iron oxides, decomposing the gangue rock and giving it a yellow and black color."

At the time of Forstner's visit, in 1903, the mine had been opened by a shaft 180 feet deep, with five levels, several hundred feet of drifts and crosscuts having been run to explore the orebody. The

---

[1] Bradley, Walter W., Cal. State Min. Bur. Bull. 78, p. 201.
[2] Cal. State Min. Bur. Bull. 27, p. 194.

Castella Development tunnel, 2760 feet long, was 120 feet below the 180-foot level, and was connected with it by a vertical winze. Some ore was produced and a small production of mercury made, using a 24-ton Knox and Osborne furnace. Nothing has been done in recent years.

Bibl: Cal. State Min. Bur., Reports, XII, p. 373; XIII, p. 604; XIV, p. 924; Chapter rep. bien. period, 1913–1914, p. 180; Bull. No. 27, pp. 193–195; Bull. 78, p. 202.

Overland Prospect is in New River district and has been slightly prospected by A. E. Yocum, the last owner according to our records. It is 40 miles by trail from the Trinity River highway.

Bibl: Cal. State Min. Bur. Bull. 78, p. 202.

Trinity Prospect. Owner, Trinity Quicksilver Mining Company, 58 Sutter St., San Francisco. Contains 51.3 acres, patented, in Secs. 21, 22, T. 38 N., R. 6 W., adjoining the Altoona Mine on the northwest. Not recently active, and undeveloped.

SOAPSTONE.

Soapstone occurs on Browns Mountain in Sec. 21, T. 33 N., R. 9 W., and has been used locally in fireplaces.

Bibl: Cal. State Min. Bur. Bull. 38, p. 353.

VOLCANIC ASH.

Liberty Bell Mine. Owners, F. and L. Sarcletti, J. Merciari and J. Dallatore, French Gulch. It is in Minersville district, 35 miles from Redding, in Sec. 13, T. 34 N., R. 8 W.

The deposit consists of andesitic ash and has been prospected by an adit which was started to cut at depth a quartz vein which is said to have assayed $15 a ton on the surface.

Bibl: Cal. State Min. Bur. R. XVII, p. 544.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

SANTA CRUZ COUNTY.

Introduction.

Numbered among the original twenty-seven counties created February 18, 1850, Santa Cruz County was first known as Branciforte.[1] An amendment passed later during the first session of the legislature gave it the name of Santa Cruz, signifying 'Holy Cross.' With the exception of its northern boundary, which originally extended from the ocean due east through a point at the head of San Francisquito Creek to the summit of the Santa Cruz Mountains, the original boundaries of the county were the same as they are at present. In 1868 the northern line was moved southward and a portion of what had been Santa Cruz County was annexed to San Mateo, which had been created in 1856. The new dividing line began on the ocean shore near Point Año Nuevo, trending northeasterly to the summit of the mountains in a broken line of east and north bearing segments. Since this move in 1868 the county's boundaries have remained unchanged.

Geography.

Santa Cruz County borders on Monterey Bay and the Pacific Ocean, its curving coast-line extending from the mouth of Pajaro River, where it enters the bay, northwesterly for 40 miles. San Mateo County bounds it on the north; Santa Clara County lies to the northeast, and Monterey adjoins on the south.

The area of the county is only 435 square miles, making it, exclusive of the city and county of San Francisco, the smallest county in the state. Its population is 26,269 (1920 census). The city of Santa Cruz, the county seat, situated on the north shore of Monterey Bay, is one of the most attractive seaside resorts of California. It is noted for its long strand of bathing beach and equable climate, and is easily reached from San Francisco, 78 miles north, by rail or highway.

The county is traversed by a line of the Southern Pacific railroad from San Jose, via Los Gatos, to Santa Cruz. From there this line continues southeasterly near the coast to Watsonville, the second city in size and principal shipping center of the rich Pajaro Valley, connecting with the main line at Watsonville Junction. There is a branch line from Felton that follows San Lorenzo River northward, and another from Santa Cruz, running northwesterly along the coast to the plant of the Santa Cruz Portland Cement Company at Davenport.

A municipal pier at Santa Cruz permits the docking of ocean-going vessels. Good highways make the county readily accessible to motorists.

Pajaro Valley is noted as an apple growing district. The cultivation of fruits, berries and vegetables and the operation of packing plants and canneries are the principal industries. Poultry raising, commercial fisheries and mining are also important. The latter industry, however, is confined almost entirely to the production of nonmetallic structural and industrial minerals.

---

[1] Coy, Owen C., California County Boundaries, California Historical Survey Commission, Berkeley, 1923.

Topography.

The greater part of Santa Cruz County is rugged and mountainous. Castle Rock Ridge, which forms the eastern boundary, trends in a northwest direction, approximately parallel to the coast line at an average distance of 20 miles inland. It rises to elevations of over 3000 feet and forms an escarpment with a steep northeastern slope on the Santa Clara County side. To the southeast, between the summit and the ocean, the slope is more gradual, but the region is cut by many deep gulches formed by streams flowing westward to the sea.

Ben Lomond Mountain, which rises between Castle Rock Ridge and the ocean, also presents a steep escarpment to the northeast and a long gentle slope on the southwest to the ocean. The parallel arrangement of valleys and ridges characteristic of much of the Coast Range is not prominently developed in this county. Old sea terraces are noticeable at many places along the coast. The hillsides are generally deeply soil-covered and unusually steep, there being many V-shaped canyons in the Monterey shale areas.

In the region of San Lorenzo River and Boulder Creek the hills are heavily wooded and several redwood groves contain trees of gigantic size. The drainage basin of San Lorenzo River includes nearly one-third of the county. Pajaro River drains the southern portion, flowing westward and forming the south boundary of the county. Numerous small perennial streams flow down the west side of Ben Lomond Mountain to the sea.

Geology.

The Santa Cruz Quadrangle, the geology of which has been mapped and described by J. C. Branner, J. F. Newsom and Ralph Arnold,[1] includes the greater portion of the county. The reader is referred to this folio for a detailed geological history of the area and description of the formations.

That half of the county lying northwest of the Southern Pacific railroad (excluding only the Ben Lomond Mountain block) and Castle Rock Ridge along the eastern boundary are composed of Tertiary (Miocene) marine sandstones and diatomaceous shales. The area east of Santa Cruz and extending to the base of Castle Rock Ridge is also composed of Tertiary (Pliocene) sedimentary formations, including marine and freshwater sandstones, shales and gravels. Quaternary sands, gravels and clays predominate along the southern boundary and Pajaro River Valley. Ben Lomond Mountain is an upward-tilted granitic block, the core of which is quartz-diorite but containing relatively small areas of metamorphic schist, marble and limestone. All of the sedimentary formations have been much folded, crushed and broken and numerous faults have been noted.

Mineral Resources.

Records covering the variety, amount and value of the minerals produced in Santa Cruz County extend no farther back than 1894, but there was considerable production before that time, especially of gold, bituminous rock, limestone and lime.

---

[1] U. S. Geol. Survey Santa Cruz Folio No. 163.

Although it was 44 years after the organization of the county and 46 years after mining became an established industry in the state before any segregated county record of output was begun, in the succeeding interval of 31 years between 1894 and 1924, inclusive, the total recorded value of minerals produced has amounted to nearly $50,000,000. This large total includes no metals except a negligible amount of magnetite (iron ore) from black sand; no petroleum, the most valuable nonmetallic found in the state; and no 'war minerals,' the production of which materially increased the mineral output of many of the counties from 1915 to 1918.

In 1924 the mineral output of Santa Cruz County was valued at $4,339,233, giving it tenth place among the fifty-eight counties of the state. As will be noted by referring to the table of mineral production, the variety of commercial minerals is small and practically confined to the structural materials, bituminous rock, cement, clay, lime, and limestone, sand, gravel, and crushed rock. A number of other minerals are known to occur in the county, but they are of minor importance at their present stage of development. Among these are coal, gold, granite, iron, mineral water, and petroleum. Still other varieties mainly of mineralogical interest are cinnabar, graphite, gypsum, melanterite, and talc. Magnetite, chromite, ilmenite, garnet, olivine,

SANTA CRUZ

Year	Lime		Limestone	
	Barrels	Value	Tons	Value
1894	167,000	$138,200	4,000	$5,000
1895	145,000	133,750	12,055	12,055
1896	116,000	95,500	27,827	28,663
1897	149,600	111,800	10,688	8,005
1898	151,000	151,000	7,912	5,738
1899	161,893	176,893	4,135	3,730
1900	163,985	131,288	1,669	1,213
1901	161,500	161,500	3,845	3,595
1902	185,223	161,302	1,850	1,850
1903	220,835	185,442	3,000	2,725
1904	293,207	306,775	[2]	----------
1905	218,084	199,974	7,325	52,125
1906	255,469	347,490	11,431	55,242
1907	213,599	241,179	6,370	6,000
1908	119,996	119,996	1,178	2,167
1909	228,875	296,785	3,457	5,273
1910	214,137	230,513	4,361	6,770
1911	216,508	206,225	22,622	44,591
1912	169,646	159,505	7,307	7,553
1913	75,000	60,000	39,494	30,994
1914	173,282	157,011	14,666	25,082
1915	191,643	177,873	2,047	4,873
1916	176,263	225,485	4,318	9,820
1917	213,104	173,778	6,527	11,378
1918	182,083	285,316	7,132	15,313
1919	150,271	234,039	5,527	12,690
1920	141,633	202,908	5,062	20,101
1921	122,907	242,869	[2]	----------
1922	174,490	235,802	4,581	20,534
1923	157,660	203,632	6,733	14,242
1924	127,830	212,540	[2]	----------
Totals	5,437,723	$5,732,411	[2]237,119	[2]$614,561

[1] Includes crushed rock, rubble, sand, gravel.
[2] See under 'Unapportioned.'

zircon, quartz, and platinum are constituents of some of the beach sands.

Further development may place some of these on the commercial list, but the future production of Santa Cruz County will no doubt continue to be made up chiefly of the common structural and industrial nonmetallics which have contributed most to its mineral production in the past.

The last general report on the mines and mineral resources of the county is contained in State Mineralogist's Report XVII, 1920. The oil possibilities were discussed in Bulletin No. 89, 'Petroleum Resources of California,' 1921 (out of print).

In order that these data might conform to the new series of county reports, begun in State Mineralogist's Report XXI, 'Mining in California,' 1925, and continued in succeeding numbers, the county was visited in January, 1926. New developments, corrections and changes noted since the former reports were published are included herein.

The courteous assistance rendered by local chamber of commerce officials, property owners and operators is gratefully acknowledged.

The following table gives the total recorded output, 1894–1924, inclusive:

COUNTY, 1894-1924.

Bituminous rock		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
20,782	$79,980	-------	-------	-------	
32,067	102,486	$4,000	75 M.	$375	Brick.
43,843	109,536	4,000	497 M.	2,485	Brick.
43,179	123,056	-------	300 M.	1,500	Brick.
40,598	113,898	-------	-------	-------	
27,503	70,569	200	-------	-------	
21,960	58,590	-------	-------	-------	
13,580	30,654	-------	10 tons	30	Clay.
31,700	41,084	-------	106 tons	1,060	Asphalt.
18,426	45,190	20,750	700 cu. ft.	140	Granite.
[2]	-------	2,925	-------	-------	
17,583	42,500	1,750	-------	-------	
13,544	38,860	3,500	-------	-------	
21,955	64,707	14,800	-------	-------	
25,041	85,123	19,736	450 cu. ft. 28,400 tons	336 28,400	Granite. Clay.
31,392	110,067	20,717	63,541 tons -------	13,800 1,794,294	Clay. Unapportioned, 1900-1909.
35,565	124,195	23,425	52,970 tons -------	15,981 2,096,031	Clay. Unapportioned.
24,815	80,371	7,627	-------	2,448,339	Unapportioned.
32,146	80,439	22,710	-------	879,437	Other Minerals.
26,932	67,330	10,511	-------	1,647,970	Unapportioned.
40,540	115,500	4,276	-------	1,341,089	Unapportioned.
17,399	60,728	6,794	-------	1,331,263	Unapportioned.
[2]	-------	2,815	-------	1,440,991	Cement, marble, bituminous rock.
[2]	-------	2,368	-------	1,480,800	Cement, potash, bituminous rock.
[2]	-------	9,107	-------	2,599,717	Cement, potash, bituminous rock.
[2]	-------	17,074	-------	1,981,253	Other minerals.
[2]	-------	23,379	-------	2,834,750	Bituminous rock, cement, iron ore, mineral paint, potash.
[2]	-------	22,895	-------	3,815,121	Bituminous rock, cement, limestone, mineral paint, potash.
[2]	-------	7,398	-------	3,345,071	Cement, bituminous rock, potash.
[2]	-------	15,363	-------	3,992,668	Cement, bituminous rock, potash.
[2]	-------	29,217	-------	4,097,476	Cement, bituminous rock, potash, limestone.
[2]580,550	[2]$2,225,363	$277,337	-------	$37,190,287	

BITUMINOUS ROCK.

The deposits of asphaltic and bituminous rock in Santa Cruz County have long been known and utilized. The material is a porous, loose, fine to fairly coarse-grained sandstone, impregnated with asphaltum. These so-called bituminous rock deposits are extensive, but they have been developed at only a few places. As described by H. W. Fairbanks,[1] "The bituminous rocks are sandstone beds lying near the base of the diatomaceous shale, which is referred to as the Monterey. Most of the sandstone beds which immediately underlie or are intercalated with the diatomaceous shale of this locality are more or less bituminous. The structure is monoclinal, with a gentle southwest dip, hence the asphaltic-bearing strata crop out along the sides of the southwestward-flowing streams, where these have cut down nearly or quite to the bottom of the shale.

"The zone of the bituminous rock is exposed near the base of the diatomaceous shale from Santa Cruz northwestward as far as the western side of the Big Basin, a distance of more than 20 miles. Throughout this distance the dip of the lower part of the diatomaceous shale and of the immediately underlying sandstone is gently to the west and southwest. At many places through this district the sandstone beds are more or less bituminous, but at only one locality have they been found to be of commercial value."

Middle bed (soft) bituminous sandstone, thickness about 30 feet, City Streets Improvement Company's Mine, Santa Cruz County.

City Streets Improvement Company's Mine. Under various names, including Walrath Mines, Pacific Improvement Company's Mine, Santa Cruz Bituminous Rock Mines, and more recently City Streets Improvement Company's Mine, this property has been operating for more than 35 years. Operations have been on a reduced scale in later years, the City Streets Improvement Company having gone out of business and control of the property passed to the Bank of California, N. A., San Francisco. Since February, 1923, it has been operated under a working agreement by I. W. Moore, Box 433, Santa Cruz.

---

[1] Fairbanks, H. W., U. S. Geol. Survey Folio 163.

The property contains 479 acres, located low down on the southern slope of Ben Lomond Mountain at an elevation of 800 to 900 feet. The workings are three miles northeasterly from Gordola, the shipping point on the Davenport branch of the Southern Pacific, and about five miles in an air line northwest of Santa Cruz.

There are three distinct beds of bituminous sandstone lying practically horizontal on the property.

The lower stratum is about seven feet thick and has not been developed to any extent, as work has been confined to the upper and heavier beds. About eight feet of sand, containing a very low percentage of bitumin, separates the lower bed from the middle one. The latter is a rather coarse-grained sandstone averaging 30 feet in thickness containing from 10% to 14% of asphalt. The 'soft' bituminous rock is mined from this bed. Above this there is a bed of diatomaceous shale 50 to 60 feet in thickness, on top of which is the upper stratum of bituminous sandstone. The upper bed is a little thinner than the middle one, varying from 6 to 22 feet in thickness. It is finer-grained and harder, but contains from 14% to 18% asphalt. The 'hard' rock is mined from this bed. In use, a varying mixture of the 'hard' and 'soft' rock is used, according to the character of the work.

In early days the material was hauled to the loading station at Gordola by an immense steam tractor, hauling four or five large trailers with solid wooden wheels holding ten tons each. Much of this old equipment is still on the property.

At the present time the bituminous sandstone is mined by boring holes with augers, and blasting; the large pieces being broken to man-size with sledge and chisel. It is then loaded on 2-ton cars by hand and trammed to a loading bunker from which it is taken by 5-ton trucks to Gordola.

Many thousands of tons of this material have been produced here in the past 35 years; the entire top of Rattlesnake Hill having been cut down to a level floor representing the base of the middle bed of bituminous sandstone. The beds are still exposed in open cuts for over 1000 feet on adjoining hills, and an immense tonnage still remains readily accessible. When properly placed, the excellency of this material has been demonstrated by pavement laid 30 years ago which is still in good condition. Two to five men are employed.

> Bibl: State Mineralogist's Reports XII, p. 28; XIII, p. 43; XVII, pp. 230–232; XVIII, p. 228. U. S. Geol. Survey 22d Annual Report, Part I, pp. 384–394; Santa Cruz Folio 163. California Journal of Technology, August, 1913.

Cowell Mine. This quarry is situated six miles northwest of Santa Cruz on the extensive land holdings of the Henry Cowell Lime and Cement Company, owners. It is about one-half mile east of the City Streets Improvement Company's Mine, but on the opposite side of Baldwin Creek, which necessitates hauling direct to Santa Cruz for shipment. It has only been worked occasionally in a small way, and was idle at the time of visit.

Bibl: State Mineralogist's Reports X, p. 621; XII, p. 28; XIII, p. 44; XVII, p. 230; XVIII, p. 228. U. S. Geol. Survey 22d Annual Report, Part I, pp. 399–404; Santa Cruz Folio 163.

Thurber's Mine. This property is north of and adjoining the City Streets Improvement Company's Mine. The bed of bituminous sandstone here varies from 10 to 30 feet in thickness. It has not been extensively developed. Idle. Owner, Consolidated Bituminous Rock Co., Nevada Bank Building, San Francisco.

Bibl: State Mineralogist's Reports VII, p. 96; VIII, p. 554; XII, p. 29; XIII, p. 44; XVII, p. 232; XVIII, p. 228. U. S. Geol. Survey 22d Annual Report, Part I, pp. 393–396; Santa Cruz Folio 163.

BLACK SAND.

There are extensive stretches along the coast of California where the heavier constituents of the beach sands have been concentrated by wave action into deposits of so-called 'black sand.' The composition of this heavy concentrate varies somewhat with the locality. In general the following commercial minerals are present in greater or less amount: magnetite, gold, ilmenite (oxide of iron and titanium), garnet, zircon, hematite, chromite, and the platinum group metals.

Could each of these minerals be readily and completely separated from the others and from the olivine, quartz and other worthless constituents, they would be readily marketable. Gold and platinum are found in relatively minute amounts only, but on account of their high value, practically all past efforts to work these sands have been confined to the recovery of these metals.

Besides the uncertain profitable production of gold and platinum from this source, the use of black sand in the manufacture of artificial iron castings, where great strength is not required, has been suggested. Some experimental work has been carried on along this line including the making of sash-weights by molding or briquetting the material into the desired form with oxy-chloride (magnesite) cement, portland cement, or other binder. Black sand may also be utilized in concrete mixes where a concentrated weight is wanted, as in concrete balance-weights used on bascule-type bridges and similar structures.

By subjecting the magnetite in black sand to an oxidizing roast, it may be changed to the ferric state, producing a red oxide (Fe_2O_3), which forms when finely ground a mineral pigment suitable for the manufacture of paint. The pigment so made is said to be superior to ground hematite or the natural soft red oxide.

Magnetite in the black sands is obviously also an ore of iron. With reference to this, Day and Richards[1] in their report on the useful minerals in the black sands of the Pacific slope state, "It was found that the magnetite contained in the black sands of the Pacific slope constitutes a greater supply of useful iron ore than any other available source known on the Pacific slope. This magnetite usually contains from 5 to 10 per cent of titanium. It was found that this titanium offered no obstacle to the production of high-grade cast iron in the electric furnace, and that in a modification of this electric furnace this cast iron could even be decarburized to a very soft iron of high quality."

---

[1] Day, David T., and Richards, R. H., Useful Minerals in the Black Sands of the Pacific Slope, U. S. Geol. Survey Mineral Resources, 1905, pp. 1175–1258.

Well-known deposits of black sand occur in Santa Cruz County along many of the beaches, particularly on the northern shore of Monterey Bay from the mouth of Pajaro River to Soquel Point. The deposits are found both on the present beaches and on the older marine terraces back from the present shore line. They occur in strata from a few inches to several feet in thickness, interstratified with light beach sands. They are said to carry small amounts of platinum, as well as gold, and have been washed in the vicinity of Leonard Station and near Aptos at intervals for many years, though probably with little if any profit. Typical analyses of the natural black sand near Aptos, according to Day and Richards,[1] show their content in the following minerals to be:

Magnetite	502	to	1120	pounds	per ton
Chromite	8	to	126	pounds	per ton
Ilmenite	224	to	576	pounds	per ton
Garnet	1	to	80	pounds	per ton
Quartz	216	to	1046	pounds	per ton
Zircon	18	to	26	pounds	per ton
Unclassified	104	to	189	pounds	per ton
Gold	none	to	62	cents	per ton
Platinum	none				

At the time of visit, no one was found attempting to extract gold or platinum, but there is now a plant near Aptos utilizing the black sand as an iron ore. For a description of this plant see under Iron.

CEMENT.

Cement is the most important single structural material in the mineral output of California. As a cement producer, the state ranks third in the United States, being surpassed only by Pennsylvania and Indiana.

California now has ten operating portland cement mills, one partly constructed mill upon which work has temporarily ceased, and another plant which is nearing completion and which will probably start production during 1926.

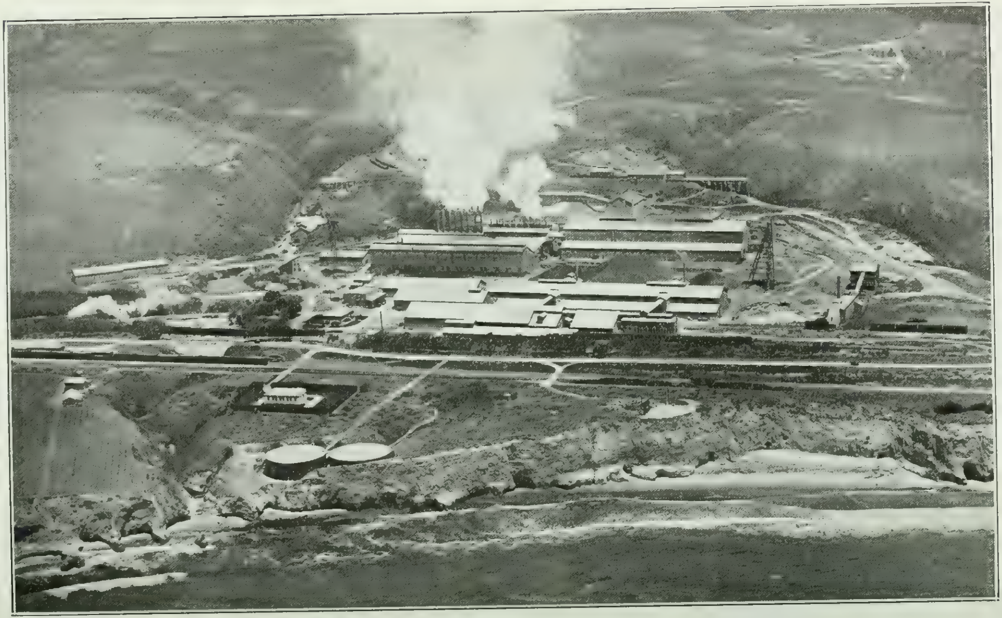
Of these, the largest single cement mill is in Santa Cruz County.

Santa Cruz Portland Cement Company; home office, Crocker Building, San Francisco; plant at Davenport, Santa Cruz County; officers, George J. Cameron, president; W. K. Berry, secretary; George R. Gay, manager; Fred Davis, plant superintendent.

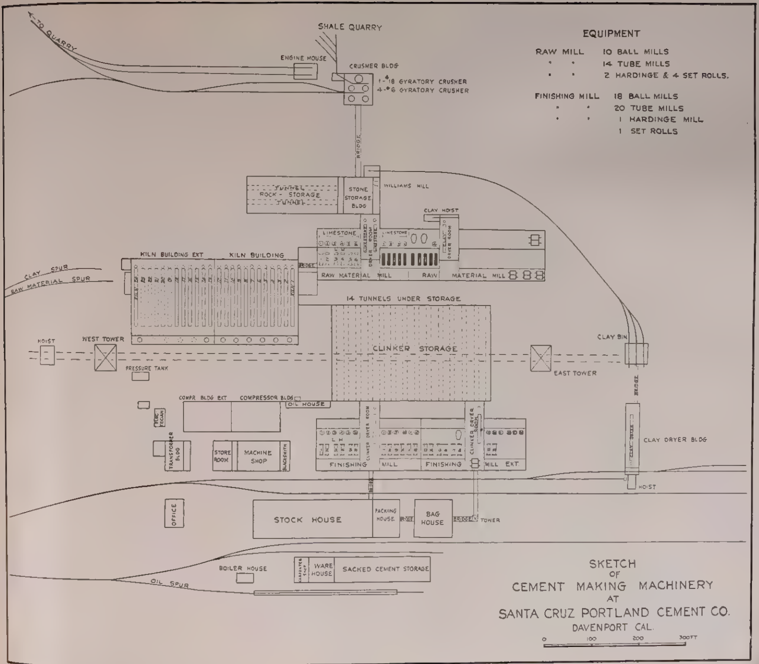
This company's mill site is at Davenport near the northern terminus of the marine terrace which borders the ocean northwesterly from Santa Cruz for 15 miles. The plant is within sound of the surf about one-half mile north of San Vicente Creek Canyon and 13 miles from Santa Cruz. A branch line of the Southern Pacific Railroad

---

[1] U. S. Geol. Survey Mineral Resources, 1905, p. 1188.



PLANT OF SANTA CRUZ PORTLAND CEMENT COMPANY, DAVENPORT, CALIFORNIA.
Airplane photo by courtesy of the company.



SKETCH
OF
CEMENT MAKING MACHINERY
AT
SANTA CRUZ PORTLAND CEMENT CO.
DAVENPORT CAL.

from Santa Cruz serves it. A good paved highway closely parallels the railroad.

The first shipment of cement was made on May 17, 1907, since which time the company has been in continuous production, although not always at full capacity. The mill at present has a capacity of 10,000 barrels per day, and 350 men are on the pay roll. Electric power furnshed by the Pacific Gas and Electric Company is used throughout, the connected load being 12,000 horsepower.

Limestone and a considerable portion of the clay used is obtained from the company quarry three miles up San Vicente Canyon. Additional clay is mined near Glendale and shipped to storage at the plant (see under Clay). The gypsum used comes from Nevada.

Additions to and changes in equipment and methods of operation, both at the mill and the quarry, have been adopted from time to time and some radical changes in the mill flow-sheet are now under way.

Additional equipment being installed will increase the mill capacity to 14,000 barrels per day. It will also permit an intimate and uniform mixture of the raw materials closely approaching or equalling that obtained in 'wet-process mills,' at the same time preserving the advantageous feature of the 'dry-process.'

The accompanying plan shows the general layout of the mill and equipment approximately as it will appear when alterations are completed, but it does not indicate the conveyor distributing system with its automatic weighing and mixture control arrangement and many other details. A low-pressure oil-burning system has replaced the high-pressure system formerly used. Hummer-screens, rolls and Hardinge mills have been added, in part replacing tube and ball mills.

The most important change at the quarry has been the abandonment of the original open quarry, worked by a single bench with steam-shovel loading, and the sustitution of a new method of quarry operation designed and put in operation by Mr. Robert A. Kinzie, Mining Engineer, San Francisco.

The quarry and new method of working have been recently described in great detail in an illustrated article by George J. Young,[1] of which the following is a brief résumé.

The plan of working is a combination of glory holes, transfer raises, bulldozing chambers, chute loading and adit transportation. Since it was put into operation, over 500,000 tons of limestone have been delivered to the mill at a greatly reduced cost.

Operations are divided into stripping and quarrying. Stripping is done by steam shovel mounted on caterpillar tractors. The overburden is loaded into dump cars which are hauled in trains by a 20-ton steam locomotive to the dump. Three trains are in operation. Stripping is carried on sufficiently in advance to provide four years' supply of limestone. About thirty men are employed on the stripping crew.

On the quarry loading-out level two haulage drifts 9 by 12 feet on 60-foot centers extend along the principal axis of the deposit. Between these drifts at an elevation of 30 feet above the haulage level are a series of bulldozing chambers. Each chamber is 80 feet in length, and 50 feet in width. Their bottom is hoppered out and connected to six chute raises, three on each side. The chute raises, 6 by 8 feet in section, are driven at an angle of 50° with the bottom angle reduced to 37° and are fitted with underswung arc-gates. Thirty-three chutes are now available for loading. The haulage cars have steel bodies of 253-cubic feet capacity and are loaded to 12 tons. Three storage-battery locomotives are used for handling the cars in the drifts. They are handled in 8 to 10-car trains, both locomotives and cars being equipped with air brakes. The cars are made up in 200-ton trains in the yard at the quarry and ten trains per day are dispatched to the mill. Two 18-ton trolley-type electric locomotives are used for this work. Cars are dumped at the plant by a revolving tipple operated by compressed air.

---

[1] Young, George J., Mining Limestone by Glory Holes in California, Engineering and Mining Journal-Press, Vol. 120, No. 7, August 15, 1925.

From the top of each bulldozing chamber, referred to previously, a raise 10 by 11 feet square extends to the floor of the quarry. These raises establish the position of the surface glory holes. They are spaced 120 feet apart. Six raises have so far been extended to the quarry level. A glory hole is started by coning out the top of the raise to an angle of approximately 60°. During the coning out the broken rock in the raises is drawn down to expose the benches that are cut. Bulldozing is done with 40% powder in the bulldozing chamber whenever necessary through man-way raises, intermediate and subdrifts. The cones, transfer raises, bulldozing chambers and chute raises are kept full of rock, the subsidence being gradual as the chutes are drawn. The capacity of a bulldozing chamber, raise and cone is about 5000 tons of broken rock, so there is considerable storage in addition to the broken rock in the pit. No serious hang-ups in the system have occurred even though one raise is drawing from a portion of the quarry that contains a good deal of clay mixed with the limestone.

A total of 75 men are employed at the quarry, including 30 in the stripping crew, for the present output of of 2000 tons per day, which is equivalent to 27 tons output per man-shift.

The deposit extends over a width of 1200 feet for approximately three-quarters of a mile. It is an homogeneous close-grained light gray to white limestone free from magnesium carbonate. The area was diamond-drilled prior to the adoption of the glory-hole method and its extent found to be greater than anticipated, the tonnage being sufficient for a long period of operation.

CLAY.

Up to the present time the clay deposits in Santa Cruz County have been only superficially studied. Common clays, suitable for brickmaking and similar uses, are known to occur along San Lorenzo River and at other points and there is no doubt a plentiful supply of such low-grade clays. In the early nineties two brickyards were in operation near Santa Cruz, but these have long since been dismantled. Deposits of cream-colored pottery clay are also said to be known, but their exact locality was not divulged to the writer.[1]

The only clay now produced in the county is that used by the Santa Cruz Portland Cement Company. It is mined near Tank Siding, 1.8

---

[1] Since the above was written the Mining Bureau has been informed that there is a "fine large deposit of pottery clay" on the property of J. B. King, Skyland; P. O. Wrights Station. This information was received too late for confirmation by personal examination.

miles southwest of Glenwood and at their limestone quarry, and used in the manufacture of cement at the company's plant at Davenport. Operations at Tank Siding are not carried on continuously; their annual requirements being taken out during the most favorable season by a few months' intensive mining operations.

Further data relative to the clays of this county will be contained in a new bulletin of the State Mining Bureau on the clay industry of California, now in course of preparation by W. F. Dietrich, Ceramic Engineer.

Bibl: State Mineralogist's Reports X, p. 625; XII, p. 383; XIII, p. 619; XVII, p. 234; Preliminary Report No. 7, p. 97.

COAL.

Several small veins of lignite coal have been found in Santa Cruz County. Prospecting for coal north of Watsonville was active during the early eighties and a little coal was mined on Corralitos Creek about that time. During the past year one of these veins in the vicinity of Corralitos was reopened and the coal sold for domestic purposes in Santa Cruz.

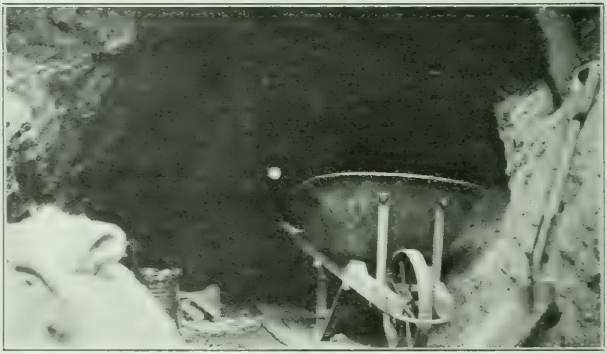
As much of the coal in California is lignite, or of such low grade that it can not be used to advantage as a steam coal, investigations have been under way in various quarters looking to a more economical method of utilizing the deposits. Research has taken the form of its possible utilization in the direct production of sponge iron and steel in the electric furnace. Others have investigated the low-temperature distillation process with the production of a semi-coke briquette, said to be an ideal smokeless domestic fuel, and various by-products. Experiments which give promise of success have been made to purify lignites and low-grade coals by some process such as the Trent method, which consists in agitating together powdered coal, water and oil. This produces a partly de-ashed plastic fuel called 'amalgam,' the oil selecting the coal particles and largely excluding the water and ash. In one experiment on a California lignite, the ash reduction amounted to 26.8%, the combustible recovery was 95%, and the sulphur reduction was 12% after treatment. Others have considered the manufacture of calcium carbide (CaC_2) from lime and lignite coal. Still other investigators have undertaken to show how these coals may be utilized in powdered form, either alone or with oil in 'collodial' fuels; to make them into briquettes without the use of an expensive binder; to manufacture producers gas from them; and to obtain for commercial use their other constituents, including ammonia, benzol, toluol, solvents, drugs, oils, and other coal tar products.

One of the newer developments is a process for extracting oil from coal, in which powdered coal held in oil is subjected to high temperature with agitation in an atmosphere of hydrogen. Under these conditions it is reported that 10 to 45 per cent of the coal will become soluble. After removal of the carrying oil there remains a pitch of asphalt-like product possibly capable of further hydrogenation.

These various possibilities lend additional interest to the development of any coal beds within the county in addition to the ordinary use of the coal for domestic fuel.

Look Coal Mine. This property comprises 10 acres situated on Redwood Canyon in Sec. 30, T. 10 S., R. 2 E. Owner, C. R. Look, 44 Clay Street, Santa Cruz. There is a good road to the mine from Corralitos, the nearest town. It is approximately 9 miles from the mine to either Watsonville or Aptos, the nearest railroad points, and 19 miles to Santa Cruz. Elevation at the mine, 800 feet. The surface rises steeply from Redwood Creek toward the west, and is thickly covered with redwood, tanbark oak and brush.

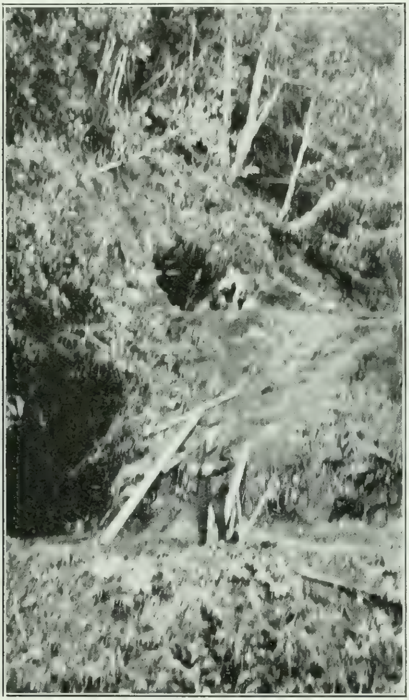
The existence of a vein of coal on this property and croppings on adjacent tracts have been known for many years, but were considered of little importance. The showing here was the most prominent and the present owner acquired the land about ten years ago, but only started work on the coal vein in 1924. Development was continued in 1925, the old adits being cleaned out and extended. A raise is now being put up on the vein from the lower to the upper adit. Between 75 and 90 tons of coal removed in doing this work was sold in Santa Cruz and vicinity. On man is employed.



Mouth of upper adit showing footwall of vein dipping about 45°, at right of wheelbarrow, Look Coal Mine, Santa Cruz County.

The vein appears to strike east-west and dips 45° south, but is exposed only near the creek level where the canyon cuts across it. Both adits are driven in on the vein and run almost due west. The lower one is in 200 feet and the upper one, about 20 feet higher and 20 feet northerly, is in 100 feet. Both roof and floor are sandstone. The vein is fairly regular but varies in width from three to four feet. The coal is a fair grade of lignite, black in color, but showing some laminations, and inclined to slack on exposure, though this slacking is not pronounced if the coal is protected from the weather. It has not proved to be a satisfactory fuel in an open fireplace, but the writer saw it burning freely with no soot in an ordinary kitchen range, giving a bright hot fire. The ash is fine, reddish gray in color, but may amount to as much as 20 per cent. No analyses have been made. The owner states that where the coal has been burned in a stove with a grate and good draft, users report it very satisfactory.

There are indications of some parallel veins nearby, but no work has been done on them. On another ranch, about one-quarter mile east of the Look workings and approximately on the strike of this vein, there is another exposure in a road cut. This may be an extension of the Look vein, but at the latter point the dip is exactly opposite, being about 45° north. Possibly this is only a localized fold or breakover. No work has been done here.



Upper and lower adits on coal vein, Look Coal Mine, Santa Cruz County.

Leonard Ranch Coal Deposit. A vein of lignite from 6 to 18 inches in thickness, lying approximately horizontal between sandstone walls, is exposed in the bluffs facing the ocean beach on the P. M. Leonard Ranch, two miles southeast of Aptos. The property is under lease as a ranch to Bontadelli and Son. In a small creek some distance back from the beach a hole about six feet deep shows 18 inches of the coal. It is black in color but laminated and friable due no doubt, in part to long exposure, as no fresh material was exposed. The bed is thicker here than on the beach, indicating that still farther inland a workable vein might be developed.

GOLD.

Gold occurs in Santa Cruz County in auriferous black sand deposits, as placer deposits in a number of creeks and gulches on the sides of Ben Lomond Mountain, and in small quartz seams on Ben Lomond Mountain. During the eighties there was considerable activity both in working the black sand deposits near San Andres and the placers and veins in the vicinity of Felton. The principal placers were on Wardell Creek, Major Creek and Gold Gulch. Colors of gold are not difficult to obtain in the gravels along Gold Gulch and some placer mining was done here as late as 1920. Former operations are described in early reports of the State Mineralogist and in the History of Santa Cruz County, by Harrison.

The industry, if it could ever have been called one, gradually diminished and it is now a matter of history, about the only reminder being a large sign Gold Gulch Drug Store over a new building on the highway to Felton, near the site of some of the early workings. The larger land holdings in this vicinity are being subdivided for summer homesites and residence purposes and it is doubtful if any tracts would be sold or leased for mining purposes.

The black sand deposit being worked near Aptos by the Triumph Steel Company for its magnetite, ilmenite and chromite content is stated by this company to carry about 20 cents per ton in gold, but so far no effort has been made to recover it. See under Iron and Black Sand.

> Bibl: State Mineralogist's Reports VIII, pp. 550–553; X, pp. 622–624; XII, pp. 243–244; XVII, pp. 235–236. History of Santa Cruz County, Harrison, p. 203.

GRANITE.

Granite has been quarried from Ben Lomond Mountain in the past. The rock, which is classified as quartz diorite, is a fair building material but is not being used at present.

There is a deposit of granite on Branciforte Creek in Sec. 29, T. 10 S., R. 1 W., which is said to present a face 700 feet high, from which large blocks could be easily quarried for rip rap or similar use. The rock is reported to be of excellent quality, and transportation would not be difficult. It is undeveloped.

IRON.

Triumph Steel Company. This company utilizes the black sand (magnetite) accumulated on the ocean beach, for producing sponge iron, alloy steel and briquetted magnetite. D. M. Crist, president; J. Harris Mackenzie, secretary; L. H. Stowell, plant superintendent. Home office, 112 Market Street, San Francisco; plant, Box 252, R. F. D. No. 3, Watsonville, Cal.

The property of the Triumph Steel Company is situated at sea level two miles southeast of Aptos. Trains, however, also stop at the plant, the station being called Cristo.

Research and experimental work on the black sands has been carried on here for several years. Originally a red iron-oxide paint pigment was produced. Later the plant was expanded and the direct production of sponge iron from magnetite begun.

The company owns a site of five acres and 1¾ miles of adjacent beach. The process of reducing the magnetite is patented and much of the apparatus in the unit in operation is of original design and manufacture.

The gray-black beach sand is taken by a drag-line scraper, operated by an electric hoist and delivered to a bin feeding an elevator. The elevator delivers the sand through a screw feeder to a rotary oil or gas-fired kiln which is used as a drier. After passing through this rotary, the thoroughly dry sand is run to another elevator which discharges into a revolving screen at the top of the plant. This screen, which is about 12-mesh, removes all pieces of shell and coarse gravel which go to the dump. The fine sand discharges to a hopper feeding the special design magnetic separator. This machine consists of a series of horizontal troughs mounted on a frame standing at an angle of about 80° from the horizontal and reaching from the lower floor to an elevation of about 40 feet. The sand from the hopper at the top is distributed in a thin film over the top trough and falls by gravity from top to bottom of the separator. In dropping from one trough to another, it passes over magnetic fields of various intensities designed to remove the separate constituents. Practically all of the magnetite is obtained in the first four troughs. As the sand flows over these, the circuit to the electro-magnets is automatically broken three times per second, pulling out and dropping the magnetite into a compartment. As the sand continues to cascade over the remaining sectors the ilmentite and chromite are segregated by regulation of the magnetic fields, each going to separate bins. The quartz garnet and other minerals constitute the tailing which is discharged.

Plant of Triumph Steel Company, utilizing black sand, near Aptos, Santa Cruz County.

Either pure magnetite, or a combination of magnetite with ilmentite or chromite as desired, is then elevated and fed to a special revolving electric-heated muck-bar tube or kiln, approximately 3 feet in diameter and 35 feet in length. The lining of this tube has nicrome heating elements imbedded, connection being made by two annular copper bands at each end, which revolve with the tube and dip in mercury troughs. Crude oil is sprayed into the feed end of the hot tube as the magnetite passes through it. The oil does not burn but is immediately gassified, the gasses reducing the iron oxide to a metallic condition as sponge iron. The sponge iron is discharged at the lower end into a briquetting press, which delivers the muck-bar billets ready for the market. Gasses from the muck-bar tube are drawn off and go to a dephlegmator, which extracts crude oil from them, and delivers an excess of CO gas, for use under the boilers or dryer.

A large amount of direct electric current is used, four days being required to bring the muck-bar tube up to operating temperature after a shut-down. All electricity is generated at the plant which is equipped with a 500-h.p. Babcock and Wilcox boiler and generators having a total of 2000 horsepower. Only a portion of the latter are used in this unit. It is said that no other process will directly produce ferro-titanium.

The plant includes a machine shop, laboratory and housing facilities. Twenty-one men are employed; the full capacity of the present unit being 50 tons of muck-bar per day. An electric furnace for the production of alloy-steel is contemplated.

The development of this direct iron-reduction process has required considerable investment in plant and research. Metallurgically it appears to be workable, but its commercial and economic success has not as yet been definitely proved.

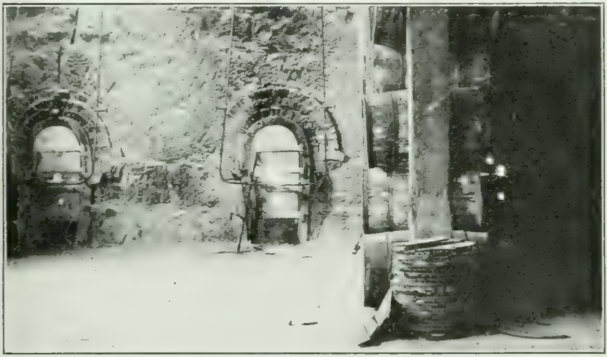
LIME.

The burning of lime is one of the earliest industries established in Santa Cruz County, the first lime kiln having been built in 1851 by I. E. Davis and A. P. Jordan. This afterward became the property of Henry Cowell, and the old pot kilns may still be seen on the Cowell Ranch alongside the road from the limestone quarry to their present kilns at Rincon.

Henry Cowell Lime and Cement Company. S. H. Cowell, president; W. H. George, secretary; home office, 2 Market Street, San Francisco. The Cowell quarry is two miles northwest of Santa Cruz and one mile up the canyon from the old quarry first worked by Davis and Jordan and later by Henry Cowell. Limestone outcrops in this canyon in many places. The rock is both coarsely-crystalline and fine-grained, white to bluish-white in color; the coarse-crystalline variety being the most abundant.

The limestone is quarried by hand drilling and shooting down with giant powder. It is all trucked from the quarry 1.9 miles to the kilns at Rincon Station on the Southern Pacific railroad. Formerly the coarse-crystalline limestone was burned in three pot kilns near the ranch house and the dense and fine-grained variety in four 34-foot Standard continuous kilns at Rincon. In 1920 three new pot kilns were added to the Rincon plant and the ones near the ranch house abandoned. The Standard continuous kilns did not work well except on the dense fine-grained rock. This variety required a greater heat for complete calcination, and the use of the continuous kilns also necessitated selective mining of the limestone to provide a suitable feed. For these reasons they are not now used and all the limestone is now burned at the Rincon plant in three pot kilns. Each kiln has a capacity of 1600 barrels and is provided with four draw doors and four burners. Fuel oil is used with steam atomization. It requires from 4 to 4½ days to burn a charge, 36 to 48 hours for cooling and 2 days to draw the burned lime. The barrels in which the lime is packed are made in a cooper shop at the Rincon plant. Twenty-five men are imployed at the kilns in addition to several at the Cowell quarry.

I. X. L. Quarry. This quarry, also owned by the company, is situated 2½ miles northwest of Felton and one-half mile north of the Holmes Lime and Cement Company's quarry. There are three pot kilns on the property. No limestone has been quarried or burned here for the past seven years.



View showing one-half of pot lime kiln from firing and draw-door floor, Henry Cowell Lime and Cement Company's Plant, Rincon, Santa Cruz County.

Holmes Lime and Cement Company. W. E. Buck, president; W. J. Feary, secretary. Home office No. 2, Pine Street, San Francisco. George N. Ley, plant superintendent, Box 7, Felton, California. This company owns and operates a limestone quarry two miles northwest of Felton. The limestone is exposed along the strike northwestward from the base to the top of the mountains, about 1000 feet. At the present time the quarry is opened on three faces. There is considerable overburden which is hauled off in dump carts. Air-drills are used, an electric motor and compressor being installed at the workings. The limestone is trammed from the quarry to the kilns and hydrating plant in 8-ton cars which are hauled back with horses. The rock is a white crystallized limestone, both coarse and fine-grained. At the plant which is situated below the quarry near the town of Felton five pot kilns are in use; one of 1000 barrels capacity and four of 500 barrels. There are also two patented continuous kilns not in use. Oil with steam atomization is used for burning. In addition to the burned lime, the plant is equipped with a Clyde hydrator having a capacity of 25 tons of hydrate per day. The hydrate is bagged by a Bates valve-bag sacker. The lime is barreled at the kilns in barrels made on the property.

Thirty-two men are employed; twelve at the quarry and the others at the kilns and hydrating plant. The quarry is an old one and has been operated over 45 years.

LIMESTONE.

Miller Quarry. This property, formerly known as the *Thurber Quarry*, contains 23 acres, situated two miles northwest of Santa Cruz, adjacent to holdings of the Pacific Limestone Products Company. The rock varies from a coarsely-crystalline white or bluish-white limestone to a finer-grained hard siliceous limerock. There is a small crushing plant containing a 9 x 14-inch Blake crusher for preparing the stone for macadam and concrete work, the only purposes for which it is used. The quarry has been worked up to the property line on one side and, as there is increasing overburden on the present face, the owner is considering starting a lower bench near water level. The quarry is worked in a small way only, an average of two men being employed the year round. Owner, W. E. Miller, 81 Church Street, Santa Cruz.

Pacific Limestone Products Company. Home office, plant and quarry at Santa Cruz; sales office, Postal Telegraph Building, San Francisco. Officers: F. W. Johnson, president; D. L. Martin, vice president; W. C. Johnson, secretary. This company was organized in 1923 and took over the old Caplatzi Quarry which had been operated on a small scale by former owners for many years. Since the property was taken over by the Pacific Limestone Products Company, the number of raw limestone products prepared for specific purposes has been greatly increased and they are now being used for terrazo, stucco dash, chicken grit, roofing grit, commercial fillers, glass manufacture, motor sand, concrete brick, cattle lime, poultry lime, fertilizer, macadam, and other uses. By the installation of additional equipment at the plant and sales promotion work carried on among prospective users of raw limestone products, the company has succeeded in quadrupling the output of the quarry in the past two years.

The property comprises 14½ acres located at the end of Spring Street, Santa Cruz, two miles northwest of the Southern Pacific depot, at an elevation of 250 feet. The deposit is a limestone rock, medium hard with very fine to very coarse crystals. The rock is shattered and broken in large masses and is bluish-white in color. The average face is 52 feet high with an overburden of from 2 to 8 feet of soil and red clay. The overburden is removed by shooting with black powder to the floor of the quarry, or else it is trapped in a 10-yard bin chute. If the overburden is shot to the quarry floor, it is picked up by a Haiss loader and loaded into wagons or trucks.

A good deal of this overburden is sold for fill material. All that is not sold is hauled to a waste dump.

Rock is blasted down with 10 to 14-foot toe holes averaging 8 to 10 feet from the face with 40 per cent L. F. Extra Giant ⅞ x 8 dynamite. Due to the many vertical seams a large amount of the rock is broken down without drilling. Air from a 6 x 7-inch single-stage Sullivan compressor furnishes power for a Sullivan 'Junior' rotary jack hammer. Pieces over 24 inches are plug shot. All rock is broken with 16-pound rock hammers to sizes less than 6 inches.

Because of mixed impurities of magnesium and silica all rock is hand-picked for its color, crystals and impurities. The piles of 6-inch rock are hauled to a No. 4 Austin gyratory crusher in 1½-yard one-horse dump carts or in one-ton Ford trucks. This crusher is about 500 feet from the present quarry face. Three men are used to fill the carts, and there is a driver for every two carts. While the driver is hauling one cart to the crusher, the other cart is being filled.

The Austin crusher reduces the stone to 2½ inches or smaller. This stone is then elevated by a bucket conveyor a distance of 50 feet to three gravity screens. The bucket elevator has 9 x 12-inch buckets spaced 12-inch centers. The screens separate out ¼, ⅛, and from ⅛ to 30-mesh sizes. The dust, if limestone is being crushed, drops into a bin directly below the screens and is sold as fertilizer. The ¼ and ⅛-inch sizes drop to bins below the screens and in front of a No. 2 Williams hammer mill, or if desired, directly into another elevator that carries them to the grit screens. Stone larger than ¼-inch goes to a storage bin. Stone is drawn from this storage bin and conveyed horizontally 20 feet to a 30-inch by 14-foot revolving screen. This screen has its cloth in four sections, and separations are made as the trade demands. Flux stone is made in two sizes from ½ to 1½ inches and from 1½ to 2½ inches. The oversize from this screen drops to a No. 2 Eureka jaw crusher. The discharge from this crusher is elevated 15 feet to a 30-inch by 6-foot revolving screen. This screen removes the dust and smaller sized crushed rock for special demands.

The discharge from the Williams mill is elevated 45 feet to a double cloth 30-inch by 10-foot revolving screen. This screen separates out four sizes. The tailings fall through a chute to a storage bin for recrushing. Each size is separated out from the screen and drops to separate storage bins. The separation from the outer screen drops to a No. 9 Rotex screen. The oversize from the Rotex screen passes to a storage bin directly over a No. 2 Williams pulverizing mill which grinds the material to fertilizer limestone. The discharge from this Williams mill is elevated 35 feet and passes over a gravity screen that separates out the oversize. The oversize is returned to the Williams mill. All fertilizer is ground to pass 22 mesh. The grits are weighed by a Howe automatic net bagger. Fertilizer is weighed on standard grain scales. All products are bagged in 100-pound lots.

The layout is simple and so arranged that the special products can be produced without any difficulty.

The plant operates the entire year. Sixteen men constitute the average working force. Four men are employed in the mill and sacking department, four men handle all hauling, and the rest are used in the quarry. During rush periods the force has been increased to 36 men.

Bibl: State Mineralogist's Report XII, p. 395; XIII, p. 631; XVII, p. 237. Pit and Quarry, Vol. 10, No. 5, June 1, 1925, pp. 55–58.

MINERAL WATER.

Although several small mineral springs occur singly and in groups within Santa Cruz County, no mineral water is bottled or commercially produced. There is little improvement at any locality except St. Francis Springs which was formerly a popular resort, long known as Chittenden Springs and later as El Pajaro Springs, where hotel accommodations were available.

Hinns Sulphur Spring. This is a small unimproved cold sulphur spring, located near the top of Hinkley ridge about one mile east of Olive Springs.

A number of other small unnamed seepages or springs of mineralized water also occur west and northwest of Olive Springs.

Olive Springs. This picturesque property, which still remains practically in its natural state, comprises 100 acres, located on Hinkley Creek near its junction with Soquel Creek and extending to the top of the ridge between the two streams.

The property is in T. 10 S., R. 1 W., and varies in elevation from 300 feet at the camping ground to 1200 feet on the ridge. It is six miles north of Soquel with which it is connected by a good road. Owner, Elizabeth J. Corcoran, Box 81, Seabright, California.

Hinkley Creek flows through a deep canyon here, the walls of which stand nearly vertical. Seepages and springs occur at numerous points in the creek bed and from the sandstone formation, which forms the canyon walls. The rock is very soft in places and in process of decomposition.

Of probably a dozen springs on the property, five have been somewhat improved by constructing small concrete basins around them. These five are known as the 'White Sulphur,' 'Sulphur,' 'Sulphur and Iron,' 'Magnesium,' and 'Magnesium and Iron' Springs, but the names mean little. All are cold.

The so-called 'magnesium and iron' spring has a flow which more than fills to capacity a 2-inch open pipe line, with a fall of 100 feet or more in a few hundred yards, leading from it to the camp grounds.

No water is sold but visitors are permitted to carry away as much as they desire.

Analysis of the 'White Sulphur' spring water by G. A. Banks, M.D., Chemist:

Constituents in parts per million.

Reaction:	
Primary salinity	29
Secondary salinity	2
Tertiary salinity	0
Primary alkalinity	0
Secondary alkalinity	62
Tertiary alkalinity	?

Constituents	*By weight*	*Reacting values*
Carbonate (CO_3)	390	12.98
Sulphate (SO_4)	234	4.80
Calcium (Ca)	180	9.00
Sodium Na	156	6.90
Phosphate (PO_4)	0	0.00
Chloride Cl	104	2.98
Magnesium Mg	86	6.92
Potassium K	2.5	.06
Total	1152.5	

Carbon dioxide (CO_2) present
Hydrogen Sulphide (H_2S) 8.2

The soft decomposed sandstone in the vicinity of the springs has been investigated with a view to utilizing it in the preparation of a cleansing compound or soap, as it is claimed to have remarkable qualities as a 'chemical clay.' It has a soluble potash content, and a small plant was erected on the property during the war period for the production of potash. A steel leaching tank and parts of what appear to be a concrete calcining furnace or evaporator remain on the ground, but as this work was carried on before the present owner took possession, the results obtained are not known. It is said that some potash was produced.

According to an analysis by E. W. Rice, of Santa Cruz, the decomposed sandstone has the following composition:

	Per cent
SiO_2 Silica	72.680
Fe_2O_3 Iron Oxide	.755
Al_2O_3 Aluminum Oxide	13.575
CaO Lime	4.305
MgO Magnesia	0.325
K_2O Potash	3.265
Na_2O Soda	1.925
Loss on ignition	3.125

St. Francis Springs. This property contains 37 acres located on the banks of Pajaro River at Chittenden Station. At least 12 cool, strongly-sulphuretted springs issue at this locality along a sloping bank near the river. The springs were long known locally as Chittenden Springs. In 1909 they were improved and opened to the public as Shale Sulphur Springs. Later the name was changed to El Pajaro Springs.

The property is now owned by the Franciscan Fathers, 133 Golden Gate Avenue, San Francisco, and is called St. Francis Springs. It has reverted to private use and probably will never again be opened as a public resort. The conversion of the buildings into a seminary is contemplated.

Bibl: State Mineralogist's Reports VIII, p. 555; XIII, p. 519; XVII, pp. 239–241. U. S. Geol. Survey Water Supply Paper 338, pp. 272, 274–276.

MOLDING SAND.

During the past year molding sand has been added to the list of commercial minerals produced in Santa Cruz County.

Daniels Transfer Company, 23 Front Street, Santa Cruz, is producing this material from a deposit at Twin Lakes. It is being used in local foundries.

This information was obtained after the completion of field work in the county and subsequent to the collection of samples of California molding sands by the State Mining Bureau for testing by the American Foundrymen's Association, so that, as yet the deposit has not been visited nor the sand tested to determine its particular characteristics and adaptability for different foundry purposes.

PEAT.

Peat is said to occur in Santa Cruz County near Felton. Small deposits may possibly be found in the vicinity of Watsonville also, as the log of an artesian well bored near the outskirts of the town showed 12 feet of peaty bog underlain by blue clay. There are probably no extensive deposits.

PETROLEUM.

There has been no commercial production of petroleum in Santa Cruz County, although small seepages of crude oil have been found and a number of wells drilled. According to J. C. Branner, J. F. Newsom and Ralph Arnold,[1] who reported only upon that portion of the county within the Santa Cruz quadrangle, "apparently the most promising locality for prospecting for oil is that along the coast west and southwest from the outcropping bituminous rock beds, since those beds pass down under overlying shale in that region. Wells drilled here, however, failed to find oil, and it is supposed that the oil which must formerly have existed in the sandstones of the region has been drained off through large fractures which extended from the surface of the shale down to the underlying sandstone. Many sandstone dykes, some of them of large size, occur along the coast in this region. These were formed from the underlying oil-bearing sandstones and the larger ones probably represent the channels through which the oil from the underlying strata escaped."

The geology and oil possibilities of the county are further discussed by Vanderleck,[2] who says, "In the area around Ben Lomond Mountain, running from Little Basin to the town of Santa Cruz, the formations consist of granitic rocks, together with areas of ancient crystalline schists. In the region to the north of this crystalline area there are outcrops of the San Lorenzo formations, the Vaqueros sandstone and the diatomaceous shale of the Monterey. These have been all sharply folded and faulted. The Monterey contains numerous seepages, but there is an almost total lack of an overlying formation which could act as a reservoir. This, together with the unfavorable structural conditions, make the possibility of obtaining oil in paying quantities in this area remote. In some cases, by reason of faulting, the oil has migrated from the Monterey into the underlying beds of the Vaqueros and San Lorenzo. It is probable that wells drilled in this area in either the Monterey, or the underlying Tertiary beds will encounter small showings of oil, but not of sufficient size to be of commercial importance.

---

[1] Geology of the Santa Cruz Quadrangle, U. S. Geol. Survey Folio No. 163, 1910.

[2] Vanderleck, Lawrence, Petroleum Resources of California, State Mining Bur. Bull. No. 89, 1921, (out of print).

"In the area between Ben Lomond Mountain and the coast, the Vaqueros and Monterey lie in a monocline, dipping about 25° to the southwest. The Monterey is heavily bituminized and has been extensively quarried for asphaltum.

"The remainder of the county, which embraces the district lying between Santa Cruz and Watsonville and southwest of the Santa Cruz Mountains, may be likened to a coastal plain. In the country north of Aptos this likeness is not generally apparent, as the hills frequently rise to a height of 1500 to 1800 feet. Between Aptos and Watsonville, however, the county is characterized by low rolling hills, varying in elevation from 100 to 500 feet. The northeast boundary is marked by the steep escarpment of the west side of the Santa Cruz Mountains, formed by the San Andreas fault. The greater portion of the district is covered by loose incoherent sands and clay, varying in color from yellow to brown and having no distinctive strike or dip. The age is not definitely known, but very probably they belong to the Merced formation (upper Pliocene). With the exception of an area about three miles northeast of Watsonville (which will be discussed below) no distinctive structure could be made out in these beds. Near the town of Santa Cruz, the Monterey shale apparently dips under the Merced beds and very probably it underlies this entire area. Between the San Andreas fault and the Santa Clara County line, is an area of Monterey shale, referred to in the article on Santa Clara County. The shale apparently lies in a synclinal trough; the eastern limb resting on the Franciscan; the axis of the syncline approximately coinciding with the county line and the west limb is faulted against the Merced beds by the San Andreas fault.

"On the Mount Madonna road, about four miles north of Watsonville and about one-half mile south of the Casserly school, is the axis of a small anticline in the Merced beds, the west limb of which is sharply compressed against the Monterey shales by the San Andreas fault. It is in this area that the indications of oil occur. On the Webb Ranch, it is reported that two shallow wells were drilled and obtained gas. In the canyon just back of the ranch house there is apparently a dry seepage of black oil. On the Hughes Ranch, one well was drilled up the canyon just back of the house. A depth of 700 feet was reached and considerable gas was encountered. At the present time (1921) the Cymric Oil Company is drilling a well at this location. This area may be considered as worthy of being tested. As regards the remainder of the area under discussion it is worthy of being thoroughly investigated for structure before being condemned. It is apparently underlaid by bituminous shales of the Monterey and should detailed mapping reveal any favorable structure in the Merced beds, the locality would be worth testing."

The following data regarding prospect wells drilled within the county from 1914 to 1924, inclusive, are from records compiled by the State Oil and Gas Supervisor.[1]

---

[1] Bush, R. D., Result of Wildcat Drilling in California, 1914–1924, Summary of Operations, California Oil Fields, Vol. 11, No. 1, July 1925.

		Location			Date	
Company	*Well*	*Sec.*	*T.*	*R.*	*Started*	*Depth*
Cymric Oil Company	1	14	11S	2E	1921	1500
Danish Oil and Development Company	1	22	11S	2W	1922	1200
Danish Oil and Development Company	2	22	11S	2W	1923	2400
Rhoads and Schmitt	1	17	9S	1W	1918	1000
Santa Cruz Laveaga Trust Oil Co.	1	5	11S	1W	1924	800
United Royalties Company	1	Hughes Tract			1924	----

The Swanton Improvement Company's well No. 1 in Sec. 23, T. 11 S., R. 2 W., was reported ready to drill subsequent to the above compilation.

POTASH.

There is a small annual production of sulphate of potash, which is recovered from the flue dust and gases from the kilns at the plant of the Santa Cruz Portland Cement Company at Davenport. During the war period there was also reported to have been some potash produced from a deposit of decomposed sandstone containing soda and potash feldspar located at Olive Springs (see under Mineral Water).

STONE INDUSTRY.

(CRUSHED ROCK, SAND AND GRAVEL.)

Except at the plant of the Pacific Limestone Co., where a small tonnage of a siliceous dike rock is sorted out for macadam and concrete, there are no commercial rock-crushing plants within the county; also at the Miller Quarry (see under Lime and Limestone) a small amount of limestone is crushed for macadam and concrete. The latter output is used by the owner on road and street contract work. There is but a single producer of washed and sized sand and gravel; all other material of this kind produced being 'bank run.'

Roach Sand and Gravel Plant. Owner, E. S. Roach, 67 Peyton Street, Santa Cruz. This plant is situated on the east bank of San Lorenzo River just north of Soquel avenue bridge in Santa Cruz. The property contains 1⅓ acres. Sand and gravel are recovered from the stream bed by pumping. An 8-inch Byron Jackson centrifugal pump, with 20-foot suction pipe mounted on a barge anchored in the stream, pumps the material against a 40-foot head to a trommel screen at the top of the plant. The pump discharge-line is 8 inches in diameter and at the present time the point of discharge is 450 feet from the barge. The pump is driven by a 75-h.p. electric motor and delivers 1800 to 2000 gallons of water, sand and gravel per minute. Another 15-h.p. motor drives the revolving screens.

Two sizes of sand are produced, a coarse sand for concrete and a fine sand for plaster. The coarse gravel is graded into ½-inch, 1-inch and 2-inch sizes. These are delivered to bunkers or stock piles. The plant has an average capacity of 200 yards per day. Water pumped with the material serves for washing. Short delays occasionally occur due to slides burying the pump suction, but as a rule little trouble is experienced. The barge and pump replace a drag-line excavator formerly used. Four men are employed.

Gibson Sand Pit. E. L. Gibson, 10 Leonard Street, Santa Cruz, owns and operates a sand pit at the mouth of a small lagoon on the beach between Santa Cruz and Capitola near Black Point. The beach sand is excavated with a drag-line scraper, a Fordson tractor mounted on sills furnishing the power. The scraper dumps into a bunker from which trucks are loaded. The material is a quite uniform and fairly clean gray sand which is neither screened nor washed. About 120 yards per day can be taken out.

Taylor Sand Pit. R. S. Taylor, 246 Mission Street, Santa Cruz, has a bunker and drag-line scraper for excavating river sand from the bed of the San Lorenzo River. This pit is adjacent to the Roach Sand and Gravel Plant near Soquel avenue bridge. It is operated intermittently according to demand.

Roach Sand and Gravel Plant, on San Lorenzo River, at Santa Cruz, Santa Cruz County.

In addition to the above, other firms and individuals occasionally dig sand and gravel from various points on the river or beach, loading direct to wagons or trucks. Among them are:

Owens Bros. Transfer and Storage Company, 256 Pacific Street, Santa Cruz.

Daniels Transfer Company, 23 Front Street, Santa Cruz.

LOS ANGELES FIELD DIVISION.

W. Burling Tucker, Mining Engineer.

On account of unfinished field work in Imperial and Riverside counties, publication of the report on the mines and mineral resources of these two counties has been postponed until the April, 1926, issue.

OIL FIELD DEVELOPMENT OPERATIONS.

By R. D. Bush, State Oil and Gas Supervisor.

From November 1, 1925, to and including January 30, 1926, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
ALAMEDA COUNTY:					
Thomas & Hammell	16	3	3	1	
FRESNO COUNTY:					
Mercantile Crude Oil Co	6	20	15	7	Coalinga
Pacific Oil Co	1	20	15	13	Coalinga
Pacific Oil Co	13	20	14	36	Coalinga
Pacific Oil Co	25	20	14	63	Coalinga
Pacific Oil Co	25	20	14	64	Coalinga
Pacific Oil Co	25	20	14	116	Coalinga
Pacific Oil Co	7	20	15	122	Coalinga
Pacific Oil Co	25	20	14	137	Coalinga
Paragon Oil Co	17	19	15	18	Coalinga
Premier Oil Co	24	20	14	30	Coalinga
Bald Mountain Drilling Co	20	20	13	1	
KERN COUNTY:					
Belridge Oil Co	33	28	21	131-X	Belridge
Devils Den Products Co	24	25	18	2	Devils Den
Pacific Oil Co	27	30	24	27	Elk Hills
Pacific Oil Co	27	30	24	60	Elk Hills
Pacific Oil Co	27	30	24	61	Elk Hills
Union Oil Co	26	30	24	Elk Hills 13	Elk Hills
Union Oil Co	26	30	24	Elk Hills 14	Elk Hills
George F. Getty, Inc	32	27	27	Grimes 2	Kern River
George F. Getty, Inc	14	28	27	Lehnhardt 3	Kern River
George F. Getty, Inc	22	28	27	Tegeler 2	Kern River
Mendocino-Midway Oil Syn	28	29	21	1	McKittrick
Oleo Fluo Co	28	30	22	3	McKittrick
Safeway Oil Co	20	30	22	2	McKittrick
Associated Oil Co	20	31	23	3	Midway
Berry & Ewing	31	32	24	15	Midway
California Petroleum Corp	34	32	24	Gordon 1	Midway
Calivada Oil Co	34	32	24	3	Midway
E. & M. Oil Co	10	31	22	16	Midway
E. & M. Oil Co	10	31	22	17	Midway
H. F. Emme	24	31	22	1	Midway
H. F. Emme	24	31	22	2	Midway
H. F. Emme	24	31	22	3	Midway
H. F. Emme	24	31	22	4	Midway
King G. Gillette	21	31	22	1-A	Midway
King G. Gillette	21	31	22	1-B	Midway
King G. Gillette	21	31	22	2-A	Midway
Honolulu Consolidated Oil Co	4	32	24	31	Midway
Honolulu Consolidated Oil Co	4	32	24	33	Midway
Honolulu Consolidated Oil Co	4	32	24	51	Midway
Honolulu Consolidated Oil Co	4	32	24	52	Midway
Honolulu Consolidated Oil Co	4	32	24	54	Midway
Honolulu Consolidated Oil Co	8	32	24	58	Midway
R. B. Jackson & B. L. Todd	36	32	23	2	Midway
Midland Oilfields Co., Ltd	34	31	24	Thornber B-4	Midway
North American Oil Cons	30	21	24	31	Midway
North American Oil Cons	30	21	24	33	Midway
Pacific Oil Co	3	32	24	3	Midway
Pacific Oil Co	33	31	24	16	Midway
Pacific Oil Co	33	31	24	17	Midway
Pacific Oil Co	33	31	24	49	Midway
Pacific Oil Co	19	31	24	50	Midway
Pacific Oil Co	19	31	24	52	Midway
Pacific Oil Co	33	31	24	52	Midway
Pacific Oil Co	19	31	24	57	Midway
Pacific Oil Co	5	32	24	63	Midway
Pan American Petroleum Co	19	31	23	3	Midway
The United Oil Co	19	31	23	2-A	Midway

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
General Petroleum Corp.	32	12	23	Pacific 12	Sunset
King G. Gillette	12	11	23	1	Sunset
Julian Petroleum Corp.	32	12	23	1	Sunset
Midway Northern Oil Co.	32	12	23	12	Sunset
Pacific Oil Co.	30	12	23	86	Sunset
Little Ten Oil Co.	13	29	20	1	Temblor
Standard Oil Co.	27	11	20	Kern Co. Lease No. 2 21	Wheeler Ridge
Standard Oil Co.	27	11	20	Kern Co. Lease No. 2 22	Wheeler Ridge
King, Zier, Kettleman	13	25	19	1	--------
Main Oil Co.	28	27	24	2	--------
Milham Exploration Co.	10	28	23	Howard Sisson 1	--------
Red Rock Oil Co., Inc.	19	30	38	2	--------
A. G. Schwarz	25	29	26	1	--------
Sisson & Wisdom	35	29	20	1	--------
K. C. Wallace	7	25	20	1	--------
KINGS COUNTY:					
South Coalinga Oil Co.	35	24	19	Clarence G. Smith 1	--------
LOS ANGELES COUNTY:					
Associated Oil Co.	7	2	14	Vickers 28	Inglewood
Associated Oil Co.	7	2	14	Vickers 42	Inglewood
Associated Oil Co.	7	2	14	Vickers 43	Inglewood
Associated Oil Co.	7	2	14	Vickers 44	Inglewood
Pacific Oil Co.	8	2	14	19	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 13	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 14	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 15	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 23	Inglewood
Pacific Oil Co.	8	2	14	Baldwin 28	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 35	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 36	Inglewood
Shell Co.	8	2	14	Rindge 15	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 34	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 35	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 36	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 37	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 38	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 39	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 40	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 41	Inglewood
Standard Oil Co.	16	2	14	Stocker 3	Inglewood
Standard Oil Co.	16	2	14	Stocker 4	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 20	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 9	Inglewood
John M. Abrams	13	4	13	1	Long Beach
Abrams & Everett	13	4	13	1	Long Beach
Aiken & Delaney	13	4	13	1	Long Beach
J. W. Alford	13	4	13	1	Long Beach
Apex Petroleum Corp.—					
Cal Mex Oil & Refining Co.	13	4	13	Chandlee 1	Long Beach
Umpire Petroleum Corp.	24	4	13	Locke 36	Long Beach
Associated Oil Co.	13	4	13	Jonte 1	Long Beach
Bailes & Nall	13	4	13	1	Long Beach
Bailes & Nall	18	4	12	2	Long Beach
Barry Oil Assn.	13	4	13	2	Long Beach
Barry Oil Assn.	13	4	13	3	Long Beach
Barry Oil Assn.	13	4	13	4	Long Beach
Beesemyer & Yerkes	13	4	13	B & Y 12	Long Beach
L. Lee Bernstein	19	4	12	1	Long Beach
Bess Oil Co.	13	4	13	1	Long Beach
Bess Oil Co.	13	4	13	2	Long Beach
E. L. Blanton	24	4	13	King 1	Long Beach
M. L. Boles, Special	13	4	13	1	Long Beach
Braly Number Two	13	4	13	Bowles-Griffith 1	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Breslin, Woodward & Sheedy	13	4	13	Breslin, Woodward & Sheedy 1	Long Beach
E. S. Bruce	18	4	12	Bruce 2	Long Beach
Robert Burns	13	4	13	1	Long Beach
Bush-Voorhis Oil Co.	13	4	13	15	Long Beach
California Petroleum Corp.	13	4	13	Bryant 1	Long Beach
California Petroleum Corp.	13	4	13	Bucklin 1	Long Beach
California Petroleum Corp.	13	4	13	Campbell-Morris 1	Long Beach
California Petroleum Corp.	19	4	12	Fields 18	Long Beach
California Petroleum Corp.	13	4	13	Green 1	Long Beach
California Petroleum Corp.	13	4	13	Hilton 1	Long Beach
California Petroleum Corp.	13	4	13	Los Cerritos Syn. 1	Long Beach
California Petroleum Corp.	13	4	13	Marquis 1	Long Beach
California Petroleum Corp.	13	4	13	Wedum-Aldahl 1	Long Beach
J. L. Clark	13	4	13	1	Long Beach
E. E. Combs Business Trust No. 3	13	4	13	E. E. Combs 4	Long Beach
E. E. Combs Business Trust No. 3	13	4	13	E. E. Combs 5	Long Beach
J. M. Cooper	13	4	13	1	Long Beach
Paul L. Cooper	13	4	13	Cooper 1	Long Beach
Cooper, Schenck & Wallace	13	4	13	2	Long Beach
Cooper, Schenck & Wallace	13	4	13	3	Long Beach
Courtney Petroleum Co.	13	4	13	C-16	Long Beach
E. L. Cragen	13	4	13	1	Long Beach
E. L. Cragen	13	4	13	2	Long Beach
Craig, Burns & Co., Inc.	13	4	13	6	Long Beach
Craig, Burns & Co., Inc.	13	4	13	7	Long Beach
Craig, Burns & Co., Inc.	13	4	13	8	Long Beach
Craig, Burns & Co., Inc.	13	4	13	Delaney 13	Long Beach
Craig, Burns & Co., Inc.	13	4	13	Delaney 15	Long Beach
Craig, Burns & Co., Inc.	13	4	13	Delaney 22	Long Beach
Craigen & Gray	13	4	13	1	Long Beach
Joseph B. Dabney	18	4	12	O'Donnell 50	Long Beach
Joseph B. Dabney	13	4	13	Travers 1	Long Beach
Davis & MacMillan Co.	13	4	13	10	Long Beach
K. S. Deeds	29	4	12	Burke 3	Long Beach
A. J. Delaney	13	4	13	5	Long Beach
A. J. Delaney	13	4	13	6	Long Beach
A. J. Delaney	13	4	13	8	Long Beach
A. J. Delaney	13	4	13	9	Long Beach
A. J. Delaney	13	4	13	Delaney 12	Long Beach
A. J. Delaney	13	4	13	Delaney 19	Long Beach
L. T. Edwards	13	4	13	Calahan 1	Long Beach
Featherstone & Preston	13	4	13	Featherstone 14	Long Beach
Featherstone & Preston	13	4	13	Featherstone 15	Long Beach
Fred F. Fitch	13	4	13	Blinn 1	Long Beach
M. A. Fox	13	4	13	Fox-O'Neil 1	Long Beach
Frankley & Andrews	19	4	12	5	Long Beach
Frankley, Andrews & Zellers	13	4	13	1	Long Beach
Frankley, Andrews & Zellers	13	4	13	2	Long Beach
W. F. Gallagher Trust	13	4	13	1	Long Beach
Gem Oil Co.	13	4	13	1	Long Beach
B. E. Gerner	13	4	13	Bud Gerner 3	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 11	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 12	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 13	Long Beach
Gillespie & Broadway	13	4	13	1	Long Beach
J. P. Harper	13	4	13	1	Long Beach
Havenstrite & Baker	13	4	13	H & B 4	Long Beach
Henderson Petroleum Corp.	13	4	13	21	Long Beach
Henderson Petroleum Corp.	13	4	13	25	Long Beach
Henderson Petroleum Corp.	13	4	13	23	Long Beach
Herwick Interests	13	4	13	Herwick 25	Long Beach
Herwick Interests	13	4	13	Herwick 26	Long Beach
R. E. Ibbetson	13	4	13	7	Long Beach
George W. Johnson	13	4	13	3	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
George W. Johnson	13	4	13	4	Long Beach
George W. Johnson	13	4	13	5	Long Beach
Sam Johnson	13	4	13	Sam Johnson 1	Long Beach
Julian Petroleum Corp.	13	4	13	Amsel 1	Long Beach
Julian Petroleum Corp.	13	4	13	C. M. & M. 3	Long Beach
Julian Petroleum Corp.	18	4	12	Patton & Avdell 1	Long Beach
Keck & McWherter	13	4	13	1	Long Beach
Keck & McWherter	13	4	13	2	Long Beach
Keck & McWherter	13	4	13	3	Long Beach
Keck & McWherter	13	4	13	4	Long Beach
Kenney & Macrate	24	4	13	3	Long Beach
Kenney & Macrate	13	4	13	Kenney-Macrate 2	Long Beach
A. H. & R. M. Kiesau	13	4	13	1	Long Beach
Kohlbush & Johnston	13	4	13	2	Long Beach
Kupfer-Williams Co.	19	4	12	1	Long Beach
Lacy, McLachlen & Lacy	13	4	13	McLachlen 1	Long Beach
W. I. Lake	13	4	13	1	Long Beach
Lewis-Glass Oil Co.	13	4	13	1	Long Beach
Lindauer Oil Co.	13	4	13	2	Long Beach
Lindauer Oil Co.	13	4	13	3	Long Beach
Lindauer Oil Co.	13	4	13	4	Long Beach
Harry E. MacAdam	13	4	13	1	Long Beach
Marine Corp.	13	4	13	54	Long Beach
The McKeon Oil Co.	13	4	13	3	Long Beach
The McKeon Oil Co.	13	4	13	4	Long Beach
The McKeon Oil Co.	13	4	13	5	Long Beach
The McKeon Oil Co.	13	4	13	6	Long Beach
The McKeon Oil Co.	13	4	13	7	Long Beach
The McKeon Oil Co.	13	4	13	8	Long Beach
The McKeon Oil Co.	13	4	13	9	Long Beach
The McKeon Oil Co.	13	4	13	McKeon-Cerritos 1	Long Beach
John McNeice and J. W. Nard	13	4	13	Norwood 1	Long Beach
E. J. Miley	13	4	13	Los Cerritos 1	Long Beach
E. J. Miley	13	4	13	Los Cerritos 2	Long Beach
Miller & McKinnis	13	4	13	Marine Trust & Savings Bank 1	Long Beach
Miller & McKinnis	13	4	13	Marine Trust & Savings Bank 2	Long Beach
J. E. O'Donnell	19	4	12	Berry 1	Long Beach
J. E. O'Donnell	18	4	12	O'Donnell 49	Long Beach
J. E. O'Donnell	13	4	13	O'Donnell 51	Long Beach
J. E. O'Donnell	18	4	12	O'Donnell 52	Long Beach
J. E. O'Donnell	19	4	12	O'Donnell 54	Long Beach
Ozark Oil Co.	13	4	13	1	Long Beach
Ozark Oil Co.	13	4	13	2	Long Beach
Ozark Oil Co.	13	4	13	3	Long Beach
Ozark Oil Co.	13	4	13	4	Long Beach
Painted Hills Oil Assn.	13	4	13	9	Long Beach
W. A. Playter	13	4	13	Bunny 1	Long Beach
Rainbow Petroleum Co.	18	4	12	4	Long Beach
Rainbow Petroleum Co.	19	4	12	5	Long Beach
Rainbow Petroleum Co.	18	4	12	6	Long Beach
Rainbow Petroleum Co.	13	4	13	7	Long Beach
Rainbow Petroleum Co.	13	4	13	8	Long Beach
Repetto Hills Petroleum Corp.	13	4	13	3	Long Beach
Repetto Hills Petroleum Corp.	13	4	13	4	Long Beach
Retsof Drilling Co.	13	4	13	76	Long Beach
Retsof Drilling Co.	13	4	13	77	Long Beach
Retsof Drilling Co.	13	4	13	78	Long Beach
Retsof Drilling Co.	13	4	13	79	Long Beach
Retsof Drilling Co.	13	4	13	80	Long Beach
Retsof Drilling Co.	13	4	13	82	Long Beach
Retsof Drilling Co.	13	4	13	83	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
J. A. Rhea	13	4	13	1	Long Beach
Ring Petroleum Corp	13	4	13	5	Long Beach
J. T. Robertson Co	13	4	13	3	Long Beach
J. T. Robertson Co	13	4	13	4	Long Beach
Royal Oil Co	13	4	13	1	Long Beach
Star Petroleum Co	13	4	13	Colby 1	Long Beach
Walter P. Temple Oil Co	13	4	13	1	Long Beach
W. O. Todd	13	4	13	1	Long Beach
Transport Oil Co	13	4	13	15	Long Beach
Tryon & Brain	13	4	13	Lineberger 1	Long Beach
The United Oil Co	13	4	13	3	Long Beach
The United Oil Co	13	4	13	Cook 1	Long Beach
The United Oil Co	19	4	12	Hass 1	Long Beach
The United Oil Co	13	4	13	Lineberger 2	Long Beach
The United Oil Co	13	4	13	Lineberger 3	Long Beach
The United Oil Co	13	4	13	Stakemiller 1	Long Beach
The United Oil Co	13	4	13	Taylor 1	Long Beach
The United Oil Co	13	4	13	Taylor 2	Long Beach
W. M. C. Syndicate	13	4	13	1	Long Beach
Weaver Bros. Drilling Co	24	4	13	2	Long Beach
Wheeler & O'Brien	13	4	13	Starr 1	Long Beach
H. L. Whiston	18	4	12	2	Long Beach
H. L. Whiston	18	4	12	3	Long Beach
Wilshire Oil Co., Inc	13	4	13	Wilshire A-1	Long Beach
L. V. Wilson	13	4	13	1	Long Beach
McGinley Oil Co	6	23	11	24	Montebello
St. Helens-Riverside Properties	2	2	12	Monterey 11	Montebello
Standard Oil Co	6	2	11	Baldwin 65	Montebello
Standard Oil Co	6	2	11	Temple 16	Montebello
Superior Oil Co	2	2	12	Manz 1	Montebello
Barnsdall Oil Co	18	3	13	O'Dea 8	Rosecrans
Barnsdall Oil Co	18	3	13	O'Dea 9	Rosecrans
Walter H. Fisher Corp	7	3	13	15	Rosecrans
Union Oil Co	18	3	13	Howard Park 13	Rosecrans
Union Oil Co	17	3	13	Padelford 3	Rosecrans
Union Oil Co	19	3	13	Rosecrans 7	Rosecrans
California Petroleum Corp	5	3	11	Wickham 2-A	Santa Fe Springs
General Petroleum Corp	5	3	11	Santa Fe 18-A	Santa Fe Springs
California Petroleum Corp	8	4	14	Waldron 2	Torrance
C. C. M. O. Co	9	4	14	Del Amo 29	Torrance
C. C. M. O. Co	9	4	14	Del Amo 40	Torrance
C. C. M. O. Co	9	4	14	Del Amo 46	Torrance
C. C. M. O. Co	8	4	14	Del Amo 80	Torrance
C. C. M. O. Co	8	4	14	Del Amo 86	Torrance
C. C. M. O. Co	8	4	14	Del Amo 92	Torrance
Wm. E. Garner	18	4	13	2	Torrance
General Petroleum Corp	8	4	14	Carson 6	Torrance
George F. Getty, Inc	8	4	14	Torrance 28	Torrance
Shell Co	9	4	14	Redondo Comm. 7	Torrance
Shell Co	9	4	14	Redondo Comm. 8	Torrance
Shell Co	9	4	14	Redondo Comm. 13	Torrance
Standard Oil Co	22	4	14	Marble Lease 2 6	Torrance
California Petroleum Corp	17	2	11	Seward-Rideout 4	Whittier
Burlingham Petroleum Corp	11	4	12	Dubin 1	
D. & B. Oil Co	3	2	10	1	
Jeffrey, Overton & Halfhill	13	11	14	Jeffrey 1	
Marland Oil Co	26	2	14	Connolly 1	
Marland Oil Co	32	5	17	Wickham 1	
Milham Exploration Co	11	4	16	Conroy 2	
Milham Exploration Co	34	2	15	Playa del Rey 2	
Pan American Petroleum Co	2	3	15	Pacific Southwest 2	
George R. Rider	12	3	15	1	
Rudd-Asmussen	9	6	12	1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
MERCED COUNTY:					
Henry L. Kuns	5	12	9	2	
MONTEREY COUNTY:					
Associated Oil Co	2	20	6	1	
Harriman Jones Oil Co.	21	19	6	2	
NAPA COUNTY:					
H. Rambke	29	8	3	1	
ORANGE COUNTY:					
Shell Co.	2	3	10	Orange 10	Brea Olinda
Union Oil Co.	1	3	10	Stearns 66	Brea Olinda
Union Oil Co.	1	3	10	Stearns 67	Brea Olinda
E. L. Blanton	17	3	9	Gaulden 1	Coyote Hills
Chiksan Oil Co.	18	3	9	1	Coyote Hills
Union Oil Co.	22	3	11	McNally 1	Coyote Hills
Julian Petroleum Corp.	7	6	10	Farnsworth 1	Huntington Beach
Standard Oil Co.	29	5	11	Bolsa 23	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 24	Huntington Beach
Standard Oil Co.	34	5	11	Huntington A 30	Huntington Beach
Standard Oil Co.	4	6	11	Huntington B 40	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B 41	Huntington Beach
Standard Oil Co.	34	5	11	Huntington B 42	Huntington Beach
Standard Oil Co.	4	6	11	Huntington B 43	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B 44	Huntington Beach
Standard Oil Co.	12	6	11	Newland 1	Huntington Beach
Julian Petroleum Corp.	21	6	10	Mesa 4	Newport
Julian Petroleum Corp.	21	6	10	Strowbridge A-1	Newport
Julian Petroleum Corp.	21	6	10	Mesa 5	Newport
Julian Petroleum Corp.	21	6	10	Strowbridge B-1	Newport
J. J. Rekar	21	6	10	2	Newport
J. J. Rekar	21	6	10	3	Newport
Sunland Oil Assn.	21	6	10	2	Newport
California Petroleum Corp.	33	3	9	Richfield Cons. 11	Richfield
California Petroleum Corp.	28	3	9	Yarnell 18	Richfield
General Petroleum Corp.	28	3	9	Thompson 7	Richfield
S. H. Keoughan, Trustee	29	3	9	Kraemer-Keoughan 1	Richfield
Union Oil Co.	33	3	9	Yorba Linda Group 9	Richfield
Standard Oil Co.	26	5	10	Plavan 1	
SAN BENITO COUNTY:					
Reorganized Homestake Divide Mining Co.	14	17	11	2	
SAN DIEGO COUNTY:					
George O. MacGregor	19	16	3	1	
SAN LUIS OBISPO COUNTY:					
Carissa Oil Co.	26	32	22	1	
Kerntaft Petroleum Co.	35	12	25	1	
Fred C. Macomber	33	12	25	1	
Portland Petroleum Corp.	31	27	15	Whitley 1	
E. K. Potter	15	32	22	1	
SANTA BARBARA COUNTY:					
Smith & Barmore	--	4	26	1	Summerland
J. R. Steele	24	6	32	1	
SANTA CLARA COUNTY:					
Alfred Tinally	7	8	1	1	
SONOMA COUNTY:					
Tom Burger	--	5	6	1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
VENTURA COUNTY:					
Calumet Oil Co.	3	3	19	15	Bardsdale
J. A. Hess	33	2	20	8	Conejo
Surprise Oil Syn.	33	2	20	9	Conejo
Surprise Oil Syn.	33	2	20	10	Conejo
Surprise Oil Syn.	33	2	20	11	Conejo
Surprise Oil Syn.	33	2	20	12	Conejo
Ruth J. Bishop	34	5	19	1	Sespe
White Star Oil Co.	33	5	19	20	Sespe
Oak Ridge Oil Co.	18	3	20	Willard 19	So. Mountain
Associated Oil Co.	22	3	23	Hartman 3	Ventura
Associated Oil Co.	27	3	23	Lloyd 27	Ventura
Bolsa Chica Oil Co.	22	3	23	Hartman 1	Ventura
General Petroleum Corp.	28	3	23	Notten 10	Ventura
Milham Exploration Co.	19	3	22	Sexton 1	Ventura
Petroleum Securities Co.	28	3	23	Willett 1	Ventura
Shell Co.	28	3	23	Edison 6	Ventura
Shell Co.	27	3	23	Gosnell 18	Ventura
Shell Co.	28	3	23	Gosnell 19	Ventura
Shell Co.	28	3	23	Gosnell 20	Ventura

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

THE SO-CALLED "MYSTERIOUS WHITE METAL."

FRANK SANBORN, Mineral Technologist.

For at least 30 years past, reports of a 'mysterious white metal' have come to the State Mining Bureau at irregular intervals, from several localities in California but particularly from the 'lava beds' area of Modoc and Lassen counties. During the latter part of 1921, the subject was given special attention in the laboratory of the State Mining Bureau and by the U. S. Bureau of Mines Rare and Precious Metals Experimental Station at Reno, Nevada.

The correspondence and the conclusions reached at that time were published [1] with the comment that they "should retire the ghost of this 'mysterious metal' at once and for all time." On the contrary, however, like Banquo's ghost it still persists in periodically reappearing. Only recently, the writer has had to demonstrate on several occasions that there is nothing either mysterious or rare or new about the results obtained. For this reason we are republishing herewith the correspondence above referred to, and also a circular just to hand from the U. S. Bureau of Mines (see page 104).

"CALIFORNIA STATE MINING BUREAU

San Francisco, California, February 4, 1922.

"DR. S. C. LIND,
Supt. U. S. Bureau of Mines Experiment Station,
Reno, Nevada.

re 'white metal' investigation:

DEAR SIR: "As stated in our letter of April 11, 1921, this subject has come to the attention of the laboratory of the State Mining Bureau at various times during the past twenty years or more. Until recently the samples submitted came entirely from the northern end of the state, particularly Lassen and Modoc counties, and they have invariably been basic igneous rocks, mainly basalt.

"In no case have we been able to reduce or produce any 'white metal' from the materials submitted. Of a number of samples investigated and analyzed, it was noted that the material usually contained rock-forming minerals which rendered the rock rather easily fusible, also the element titanium was present. From the behavior under these tests, our present chemist, Mr. Frank Sanborn, suggests that in fusing the rocks in question it is possible that a piece of iron coming in contact with the molten mass would have a crude iron-alloy formed on the surface—possibly ferro-silicon or a complex ferro-alloy. His conclusion is that the so-called 'white metal' is probably such an alloy.

---

[1] Report XVIII of State Mineralogist, pp. 86–88, Feb. 1922.

"He also learned that a friend of his, Mr. C. F. Sherwood, 503 Market street, San Francisco, spent considerable time and money in 1920–21, investigating this 'mysterious metal,' or 'white metal' in hopes that he could form a hard steel with acid-resisting properties suitable for mine pumps, cyanide filters, etc. The rock came from Modoc County, California. The following is a copy of a complete analysis made on this material by Walter L. Gibson, Oakland, Cal.:

"WALTER L. GIBSON,
successor to
Assay Office, Chemical Laboratory,
824 Washington Street,

Oakland, Cal., September 16, 1920.

"The Oliver Sherwood Company,
503 Market street,
San Francisco, California.

"GENTLEMEN: A sack of rock deposited by you at this laboratory for analysis, further known as Lab. 69482, gave the following results:

Silica	44.50%	
Sulphur	0.27 }	Combined
Iron	0.23 }	as $F.S_2$
Iron oxide (Fe_2O_3)	9.89	
Iron oxide (FeO)	7.55	
Alumina	10.51	
Lime	10.00	
Magnesia	3.82	
Titanium oxide (TiO_2)	2.00	
Phosphoric acid	0.90	
Water @ 100 C.	2.30	
Water above 100 C.	2.00	
Potassium oxide (K_2O)	0.57	
Sodium oxide (Na_2O)	5.10	
Carbonic acid gas (CO_2)	Trace	
Nickel	Trace	
Total	99.64%	

(Signed) WALTER L. GIBSON."

"Mr. Sherwood informed our Mr. Sanborn that his investigations did not yield any results of practical value.

"On several occasions during the past eighteen months when such rocks have come to the State Mining Bureau for identification, we have written the parties, asking for a sample of the metal said to have been reduced; but we have not yet received any in reply. Recently, however, a sample was brought in by a party who had become 'interested in the mysterious metal.' He had a generous sample of the rock and some of the metal claimed to have been reduced from it. This metal resembled the skimmings from a mass of molten solder, and proved to consist mainly of lead with impurities (apparently tin, copper, etc.). This metal could not have come from the rock that was submitted for identification.

"Dr. A. S. Eakle, professor of mineralogy, University of California, states that in the summer of 1915 while in Mono County, California, near Topaz, an occurrence of such a 'white metal' ore was reported to him and that he gathered some samples of the rock which proved to be quartzite containing pyrite. His informant repeated his experiments in Dr. Eakle's presence; and although not as successful in obtaining an actual reduction of metal as in his reported tests, Dr. Eakle says that the following had probably occurred: As the material was heated in a blacksmith's forge, there was plenty of carbon (coal or coke) present to reduce some iron from the pyrite. The iron may have alloyed with some silica to form ferro-silicon, or with some carbon to form steel. The hole made in the shovel in the reported tests may have been made by the sulphur attacking the shovel rendering it brittle at the point of attack or the forge blast may have burned a hole through if the shovel was worn thin.

"Under separate cover we are mailing you samples of rocks from two localities received at this office as yielding the 'white metal.' Needless to say, we found none such in either sample. As our laboratory is equipped for qualitative work only, we are limited in our scope when it comes to research work.

"We will appreciate copies of your report when you have completed these investigations.

Very truly yours,

(Signed) FLETCHER HAMILTON,
State Mineralogist."

"DEPARTMENT OF THE INTERIOR
Bureau of Mines
Rare and Precious Metals Experiment Station,
Reno, Nevada.

February 10, 1922.

"MR. FLETCHER HAMILTON,
State Mineralogist,
San Francisco, California.

"DEAR SIR: I am very much indebted for your letter of February 4th on this subject. The question of 'white metal' has also been brought to our attention repeatedly during the past several years.

"At one time in Colorado we examined very carefully a specimen of rock supposed to contain 'white metal' and were unable to detect anything which should give the properties alleged to iron. Since coming to Nevada, we have reviewed the whole subject very carefully with the Mackay School of Mines, and consulted other authorities. The consensus of opinion seemed to be that there was nothing in the claims whatsoever, and we decided that the problem was not worthy of further investigation and made no publication on the subject.

"If unusual properties are imparted to iron in forging it in the presence of such rock we believe that they are due to the heat treatment and also that a surface alloy may be formed, as suggested by Dr. A. S. Eakle, quoted in your letter.

"We do not propose to make any investigation of the present sample from Modoc County, as we had long ago decided the subject does not merit further work, and we are very pleased to be confirmed in this view by your opinion."

Very truly yours,

(Signed) S. C. LIND,
Superintendent.

THE LEGENDARY "WHITE METAL" AND ITS "ORE." *

By C. W. DAVIS.[1]

"As a by-product of its investigational work, the Rare and Precious Metals experiment Station, at Reno, Nev., of the Bureau of Mines, is from time to time requested to identify worthless rocks that are usually submitted in good faith by prospectors, miners, and others who think the rock may contain elements of value. Usually a cursory inspection or a few simple tests is all that is necessary to reveal the nature of the barren material, and the finder usually accepts the bureau's statement that the material is worthless. Sometimes it is not so easy to convince the hopeful searcher, and he may even visit the Station in person and ask to be permitted to view a test, or even to demonstrate the qualities of the 'rare' mineral that he has found. One of the most difficult fellows to convince is the seeker of 'white metal.'

"There is a legend that Mexicans and other old settlers in the Southwest knew of an 'ore' which was packed around pieces of iron or steel that they wished to harden. The metal was heated in a wood fire in contact with the 'ore' and then quenched in water. Axles of springless wagons so treated were said to have been made 'glass

---

* Circular No. 6000, U. S. Bureau of Mines, Dec. 1925.

[1] Associate Chemist; Rare and Precious Metals Experiment Sta. (Reno, Nev.) Bureau of Mines, Dept. of Commerce. In cooperation with Mackay School of Mines, Univ. of Nevada.

hard,' and to wear two or three times as long as ordinary axles and tires so treated were described as 'ringing like a bell' when suspended and struck with a hammer. This action was said to be due to a 'white metal' that was extracted from the 'ore' and alloyed with the iron by the treatment.

"Although this story has never been shown to have had any fact as a basis, it appears from time to time under slightly different guises. As a result, for over 20 years, various laboratories at different times have received many kinds of rocks (designated as 'ores') which have been claimed to give remarkable properties to metals, such as making them 'glass hard,' extremely tough, or resistant to corrosion. Many of these rocks are basic igneous rock, such as altered diabase, olivine, pyroxenite, obsidian, basalt, amphibolite, also pyritic quartzite, aluminum silicate, magnetite, tourmaline, sandstone; in fact almost every known rock is represented. Most of the samples come from California and Nevada, but nearly all western States are included.

"The claimant's method is usually to heat the metal in contact with the rock, supposing that a 'white metal' is produced from the 'ore' which alloys with the metal being treated. The temperatures used have ranged from 200° F. to that of the electric arc. The favorite heating device is the blacksmith's forge. The extraction of the 'white metal' itself (which, it was said, could be used directly in forming an alloy, as for example by putting a little on a knife blade and heating in a bunsen flame[1]) was described as having been performed in some cases by simply melting the 'ore,' in others by melting with fluxes, and in others by melting with fluxes and a reducing agent.

"The bureau's laboratory at Reno has in the past few years received various samples of this sort, some of the claimants presenting their samples in person and endeavoring to demonstrate the virtues of their 'process.' As was to be expected, the results indicate that work along this line, and money put into propositions involving the 'mysterious white metal' and its 'ore,' would be wasted.

"The tests by the bureau and other laboratories, following the claimant's procedures have usually shown no hardening effect, although in a few tests some hardening of iron or steel was produced due either to case hardening from heating the metal in contact with carbon, protected from oxidation by a coating of flux, or in some instances to the formation of a crude silicon alloy. Many ordinary fusible rocks, and even fluxes without rock, will give these same results. The claim of 'glass hardness' for treated metal is obviously caused by hard slag sticking to the metal being mistaken for hardened metal. The protection of the treated metal against corrosion was improved.

"A certain basis for confusion lies in the fact that some rocks when mixed with soda (sodium carbonate or bi-carbonate) placed in a crucible, and heated in a blacksmith's forge, give white pellets of very pure iron which are not readily attacked by acids, leading the experimenter to believe that he has one of the platinum metals.

"For example, one claimant alleged that his 'ore' when powdered and sprinkled on Norway iron and heated in a forge, would cause the surface of the metal to be coated with a lustrous, glass hard noncorrodible material, and the iron would change to steel. A treated specimen was submitted to the bureau station at Berkeley, Cal.[2] An analysis showed the ore to be obsidian. A small bar of Norway iron was packed in the powdered mineral and heated electrically above the fusion point of the mineral *in the absence of carbon*. The submerged part acquired a brilliant silver-like luster, but was not hardened or changed in any other way. The effect was apparently nothing more than a thorough cleansing of the surface, which no doubt would be less corroded than a surface more or less coated with iron oxide. The alleged 'glass hardness' of the submitted specimen was shown to be due to small masses of the fused mineral adhering to rough spots on the surface of the metal.

"In another instance, the 'ore' was basalt; the claimants were positive of the hardening effect, and attempted to demonstrate this by heating quarter-inch square bars of Norway iron to a bright red in a forge, dipping them in the powdered mineral, and repeating the process until the end of the bar was well coated with slag. On quenching in water the coated portion showed a lustrous surface, and on twisting the bar the treated part proved to be somewhat hardened. This, however, was found to be due to case hardening caused by particles of coke which were held in contact with the iron by coating of fused mineral, this coating also excluded oxygen. Many other cases similar to these were all easily explained, and lead to the conclusion that the claimants were mistaken as to what could be accomplished by the 'ores.'

---

[1] A case investigated at the Mackay School of Mines.

[2] Investigated by L. M. Duschak.

"All attempts of investigators to extract 'white metal' from 'ore' following the directions of claimants, have usually failed to yield any metal whatever, except when the treatment called for the fluxing at high temperature with charcoal of a rock that happened to contain considerable iron. In this case a small amount of metallic iron was reduced from the iron mineral of the rock. The specimens of the 'white metal' said to be 'melted' from the 'ore' are invariably impure metals, mostly lead, copper, zinc, and iron, or simply slag. In testing some of these, it was found that the lead had been introduced by fluxing the rock with charcoal in an old assay crucible that had contained a little slag high in lead, the slag being reduced and lead formed. Lead, copper or zinc in some specimens had been introduced as impurities in the fluxes used for treating the 'ore' or by using a container in which they were present, as for example, zinc from galvanized iron.

"One sample of pulverized 'ore' (volcanic rock) was claimed to produce 'white metal,' by melting with flux in an electric arc with carbon electrodes, that would harden steel, iron, and copper. A test[1] of this method, using a carbon ladle as container, showed the 'white metal' to be iron.

"Another claimant stated that 'white metal' could be produced by fusion in a carbon ladle as described above, also by reduction in crucibles using fluxes and carbon. The metal was said to harden copper or brass and to make cast iron malleable. In addition to the ladle test[2] the rock was reduced in clay crucibles by fluxing with soda and borax, with and without the addition of carbon. Without carbon no metal was produced. With carbon a small amount of metallic iron, contained in the original ore, was produced.

"In several other instances, the only metal produced from the 'ore' proved to be iron reduced from the rock by heating with carbon. Many samples of metal claimed to have been produced from 'ore' were lead which had been introduced during 'extraction' of the metal either through impure fluxes, or by reducing lead from the slag retained in old assay crucibles that had been used by the claimants in making the tests.

"A metal, said to be extracted from what proved to be a basic igneous rock, was found to be impure lead with a little tin and copper, and resembled skimmings from molten solder.[3] Another metal was found to be impure lead,[4] which the client admitted may have come from the forge where babbit had been spilled. Still another was practically pure lead reduced from the fluxes used.[5]

"White metal said to be produced from a rock that was limestone was found to be zinc, which probably came from a galvanized can that the claimant had used. Various rocks claimed to have 'white metal' virtues, said to be due to platinum, vanadium, uranium, or some other rare metal, did not contain these metals, or only slight traces, but were simply good fluxes and cleaned iron just as any good flux will, and had no power in themselves to alter the properties of the iron. Any hardening action was probably due to case hardening of the iron by the coal, coke, wood, or other fuel used, or by carbonaceous matter in the rock. In one instance it was found that when the pulverized 'ore' (basalt) was heated as requested, in contact with iron in an electric arc, the iron became hard, because it had been partly converted to a crude alloy of iron and silicon. Also, a piece of iron on repeated dipping in a powdered 'ore' as directed, quenching, and cooling, had a hard lustrous surface. This was undoubtedly due to case hardening from heating in contact with the coke in the forge, protected from oxidation by a coating of slag. Small pieces of slag attached to the metal submitted by the claimant scratched glass. The same results were obtained by a flux.

"A case in which the claimant found a coating of 'white metal' on the outside of an iron ladle used to flux his 'ore' was investigated. The 'white metal' was found to be slag.[6] Other cases where the 'white metal' was said to have 'eaten' its way through an iron shovel and plated out on the edges of the hole were studied.[7] The hole was caused by sulphides in the 'ore' which reacted with the iron of the shovel and made it brittle, and by 'burning' with the forge blast. The 'plating' was the result of the cleansing action of the flux which left the iron bright and silver-like.

---

[1] Investigator, C. C. Anthony, San Francisco, Cal.

[2] Investigator, F. S. Mulock, chemical engineer, San Francisco.

[3] Analyst, Fletcher Hamilton, State Mineralogist, San Francisco, Cal.

[4] Analyst, A. A. Hanks, chemist, assayer and metallurgist, San Francisco, Cal.

[5] W. L. Piers, assayer and chemist, Denver, Colo.

[6] Investigator, H. W. Young, metallurgist, Palo Alto, Cal.

[7] A. S. Eakle, mineralogist, Berkeley Cal.

"In sum, it may be said that all authentic tests have given results that may be thoroughly explained by the usual properties of the materials used. One is forced to conclude, therefore, that the various unsubstantial claims that have been made were due to careless tests, to erroneous conclusions from these tests or to an attempt to defraud.

"Acknowledgments.

"It is a pleasure to acknowledge the cooperation of those who so kindly informed the writer of the results of their investigations so that they might be included in this circular. Harry E. Tufft, of the Bureau of Mines, assisted in preparing the manuscript.—Information Circular, Bureau of Mines, Department of Commerce."

ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Hydraulic Mining Commission.

By an act of the legislature (Chap. 207, Stat. 1925, introduced by Assemblyman H. C. Cloudman of Berkeley) a commission was created consisting of the State Mineralogist and the Surveyor General to investigate the possibilities and the feasibility of resuming hydraulic mining of gold-bearing placer gravels. A report of their findings is to be made to the legislature at its forthcoming session in 1927.

Personnel.

Mr. Arthur Jarman, mining engineer, has been engaged as 'secretary' and engineer for the Hydraulic Mining Commission to carry on the field surveys in connection with this investigation.

Obituary.

William Irelan, Jr., State Mineralogist of California from June 1, 1886, to May 1893, passed away at his home in Berkeley, on November 9, 1925, at the age of 85 years. The original State Mining Bureau Act was approved April 16, 1880, and a supplemental act was passed in March, 1885, providing for the appointment of a Board of Trustees to have direction and control of the Bureau. Mr. Irelan was appointed by the Governor as a member of the first board assembled under that act, and the following year was appointed State Mineralogist on the resignation of Mr. Henry G. Hanks, the first to occupy that office under the original act of 1880. Mr. Irelan was born in Delaware, and was educated in England and Germany, in which latter country he was married in 1869. He is survived by his wife, Mrs. Linna V. Irelan, and a sister, Mrs. S. T. Sniffin.

During Mr. Irelan's incumbency as State Mineralogist, the following reports were published: Report VI, Part 2; VII, VIII, IX, X, XI, Bulletin No. 1.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Bulletin No. 79. 'Magnesite in California,' by Walter W. Bradley. Cloth bound; 147 pages, and illustrated with 62 half-tone plates and 11 line-cut drawings (including maps). Price $1 postpaid.

Bulletin No. 96. 'California Mineral Production for 1924,' by Walter W. Bradley. Paper, 174 pages, and illustrated with 11 half-tone plates and 1 line map. Distributed without charge.

Mining in California (quarterly), October, 1925, being Chapter 4 (completing volume) of State Mineralogist's Report XXI, and containing the Index for the year. Price 25 cents.

Summary of Operations, California Oil Fields: Vol. 11, Nos. 1, 2, 3, and 4, July, August, September, and October, 1925, respectively.

Commercial Mineral Notes: Nos. 32, 33, 34, November-January (inc.). These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale,' issued in the form of a mimeographed sheet, monthly. It is mailed free of charge to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains in addition to its correspondence file and the library, a mine report file which includes reports on some 7500 mines and mineral properties in California.

During the period covered by this quarterly report, there were 3750 letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

Walter W. Bradley, Deputy State Mineralogist.

Estimate of 1925 Output.

CALIFORNIA'S MINERAL PRODUCTION IN 1925 AGAIN BREAKS RECORD.

The total value of the mineral production of California for the year 1925, just closed, is conservatively estimated to have been approximately $422,974,500. This is, in part, detailed in the tabulation below; but, as there are sixty mineral substances on California's commercial list, it is impractical at this early date to obtain anything approaching definite figures on other than the more important items. The blank report forms are being mailed out to the operators in all mineral lines, and the date of publication of the final and complete report will depend upon the promptness of their replies.

The estimated total of $422,974,500 is an increase of more than $48,000,000 over the 1924 production which in turn surpassed the previous record value of the year 1923. This increase is due mainly to petroleum, and in part also to cement. Reports at hand indicate an increase of at least 2,000,000 barrels of crude oil in 1925 over the 1924 yield, making a total of 231,000,000 barrels (in round numbers). Assigning an average value at this early date before reports are in hand giving results of the actual sales figures is not an easy task because of the wide variations in grades, and the price changes which have been posted during the year. Approximately 85 per cent of the crude oil produced in California in 1925 was above 20° Baumé, some of it ranging as high as 50° B.; while the low-grade oil ranged down to 9° B. Prices were raised on February 4, 1925, from $1 to $1.25 per bbl. for the lower grades, and from $1.85 to $2.40 per bbl. for the highest grades, with the intermediate grades in proportion. These prices governed until September 22d, when a reduction was posted on a graduated scale according to fields; then another drop October 27th, giving a price range of 75¢ to $2.30 per barrel, the decreases for the most part being on the low-gravity fuel grades. This has resulted in a curtailment of production from the low-gravity wells, so that on December 1st there was a "shut-in capacity" of approximately 61,000 barrels per day total. Weighting the above facts, with the quantities by grades and prices, we have taken an average value of $1.39 per barrel as at least a conservative estimate for the 1925 yield of petroleum in California.

Receipts of bullion at the mint and smelters show only a slight decrease in the gold yield for 1925. That the decrease was not greater as a result of a smaller yield from some of the larger quartz mines and from copper ores, is due to an increased recovery by the gold dredges. There was a decreased output of silver from the Rand district and from copper ores, which was in part offset by increased shipments of lead ores yielding a total of approximately 7,000,000 pounds of lead (being 2,000,000 pounds more than 1924). Copper shows a drop of around 6,000,000 pounds in amount; with zinc increasing nearly three-fold. Lead and zinc prices maintained high levels during the year, averaging 8.99¢ and 7.54¢ per pound, respectively. Copper averaged 14.1¢ per pound and silver 69.07¢ per fine ounce. Quicksilver prices advanced materially during 1925, but this did not result in increased yield.

As the demand for building materials continued active during 1925, nearly all items of the structural group will show increased quantities and total values, especially cement, brick, hollow building tile, crushed rock, sand and gravel. Magnesite shipments decreased slightly, though the prices remained practically on a level with 1924. There were no notable changes reported in the general status of the miscellaneous 'industrial' group, nor among the salines.

The estimated quantities and values for 1925 are tabulated as follows:

$13,000,000	gold.
2,141,000	(3,100,000 fine oz.) silver.
6,486,000	(46,000,000 lb.) copper.
629,300	(7,000,000 lb.) lead.
652,200	(8,650,000 lb.) zinc.
30,000	iron and manganese ores.
619,000	(7,750 flasks) quicksilver.
30.000	(250 fine oz.) platinum.
320,000,000	(231,000,000 bbl.) petroleum.
15,000,000	(210,000,000 M. cu. ft.) natural gas.
25,000,000	(12,500,000 bbl.) cement.
16,500,000	crushed rock, sand and gravel.
10,000,000	brick and hollow building tile.
887,000	(65,700 tons) magnesite.
2,000,000	other structural materials, including granite, et al.
5,500,000	miscellaneous 'industrial' minerals.
4,500,000	salines (including borates, potash, salt, et al).
$422,974,500	total value.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

FRANK SANBORN, Mineral Technologist.

The production of clays and other aluminum silicates is increasing each year in California, and in all probability many new deposits of clay and possibly deposits of andalusite and cyanite will be discovered as the state becomes more thoroughly prospected.

During 1924, 417,828 tons of pottery clay and 5290 tons of clays of the montmorillonite group were produced, the latter being utilized as a substitute for fuller's earth.

The clays of the montmorillonite group, although not suitable for pottery products, are being used in the preparation of some soaps; and when these clays have the properties of clarifying oils to the satisfaction of the refiners they are used as fuller's earth. When the peculiar properties of the montmorillonite clays are more fully known, more uses may be found for them. The fact that most of the montmorillonite clays are attacked by hot sulphuric acid, the alumina going into solution, is interesting and may lead to the discovery of new and important uses for these aluminum silicates. The alumina can be precipitated as an oxide from the sulphuric acid solution by adding a solution of tannic acid.

Many samples of clays and kaolinized rocks are received at the laboratory of the State Mining Bureau, but usually it is not possible to give the sender an entirely satisfactory report for the reason that the producers of clay products and the oil refiners decide mainly by practical tests whether a clay is satisfactory for their particular purpose. The Livermore Fire-brick Company is interested in all clays that have a very high fusing point regardless of plasticity. Possibly other manufacturers who are interested in clays could give an idea of what variety they are interested in, and in this way be informed when a clay that may meet their needs is received.

A total of 1134 samples were received and determined during the three month period covered by this report. A sample of pink andalusite from near the Julian District in San Diego County was one of those received having a mineralogical and possibly a commercial value.

* * *

LIBRARY.

Forest L. Campbell, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:
  Forty-sixth Annual Report of the Director of the Geological Survey to the Secretary of the Interior for the fiscal year ended June 30, 1925.
  Professional Paper 136—The Flora of the Ripley Formation. By E. W. Berry.
  Water Supply Paper 561—Surface Water Supply of the United States—Part I, North Atlantic Slope Drainage Basin.
  Water Supply Paper 547—Lower Mississippi River Basin.
  Water Supply Paper 556—Water Power and Flood Control of Colorado River Below Green River, Utah. By E. C. La Rue.
  Water Supply Paper 560-D—Preliminary Report on the Geology and Water Resources of the Mud Lake Basin, Idaho. By H. T. Stearns.
  Mineral Resources of the United States:
    Arsenic in 1924.
    Fluorspar and Cryolite in 1924.
    Carbon Black Produced from Natural Gas in 1924.
    Graphite in 1924.
    Feldspar in 1924.
    Potash in 1924.
    Platinum in 1924.
    Petroleum in 1923.
    Phosphate Rock in 1924.
    Magnesium and Its Compounds in 1924.
    Clay in 1924.
    Salt, Bromine and Calcium Chloride in 1924.
    Slate in 1924.
  Bulletin 767—Geology and Coal Resources of the Gallup-Zuni Basin, New Mexico. By J. D. Sears.

Bulletin 771—Ore Deposits of the Saddle Mountain and Banner Mining Districts, Arizona. By C. P. Ross.
Bulletin 773—Mineral Resources of Alaska in 1923. By A. H. Brooks.
Bulletin 774—The Copper Deposits Near Salmon, Idaho. By Clyde P. Ross.
Bulletin 777—Pre-Cambrian Rocks of Gunnison River, Colorado. By J. F. Hunter.
Bulletin 778—Chemistry of Deposition of Native Copper from Ascending Solutions. By R. S. Wells.
Bulletin 780-B—Geology of a Part of Western Texas and Southeastern New Mexico. By H. W. Hoots.

U. S. Bureau of Mines:
Technical paper 320—The Bureau of Mines Orsat Apparatus for Gas Analysis. By A. C. Fieldner.
Technical Paper 367—Value of Bituminous Coal and Coke for Generating Steam in a Low Pressure Cast-iron Boiler. By C. E. Augustine.
Technical Paper 343—Georgia and Alabama Clays as Fillers. By. W. M. Weigel.
Technical Paper 368—Paraffin Wax and Its Properties. By L. D. Wyant.
Technical Paper 369—Mechanical Safeguards in Rotary Drilling. By H. C. Miller.
Technical Paper 372—Silicosis Among Miners. By R. R. Sayers.
Technical Paper 388—Coke Oven Accidents in the United States. By W. W. Adams.
Technical Paper 346—Properties of Typical Crude Oils from the Producing Fields of the Western Hemisphere. By A. J. Kreamer.
Bulletin No. 236—Plastic Magnesia. By O. C. Ralston.
Bulletin No. 256—Garnet. Its Mining, Milling and Utilization. By W. M. Myers.
Bulletin No. 257—Review of Safety and Health Conditions in the Mines at Butte. By G. S. Rice.
Reports of Investigations:
Serial No. 2709—Consumption of Reagents Used in Flotation, 1923–24. By Thomas Varley.
Serial No. 2710—Gas Hazards in Street Manholes. By S. H. Katz, E. G. Meiter, and J. J. Bloomfield.
Serial No. 2711—Falls of Roof and Coal in Bituminous Coal Mines. By W. W. Adams.
Serial No. 2712—Temperature Control System for Dressing and Tempering Fishtail Bits. By Charles H. Shapiro.
Serial No. 2713—Coal Mine Fatalities in September, 1925. By W. W. Adams.
Serial No. 2714—Consumption of Explosives in September, 1925. By W. W. Adams.
Serial No. 2715—Consumption of Explosives in August, 1925. By W. W. Adams.
Serial No. 2716—Coal Mine Fatalities in October, 1925. By W. W. Adams.
Serial No. 2717—Consumption of Explosives in October, 1925. By W. W. Adams.
Serial No. 2718—Diatomaceous Earth (With Special Reference to Nevada). By C. W. Davis.
Serial No. 2719—Gas Mask for Protection in Air Against all Gases, Vapors and Smokes. By A. C. Fieldner, S. H. Katz, H. W. Frevert, and E. G. Meiter.
Serial No. 2720—List of Permissible Mining Equipment.
Serial No. 2721—Evaporation Losses of Gasoline in the Refinery. By Ludwig Schmidt.
Serial No. 2722—Coal Mine Fatalities in November, 1925. By W. W. Adams.
Serial No. 2723—Consumption of Explosives in November, 1925. By W. W. Adams.
Information Circulars:
Circular No. 6000—The Legendary "White Metal" and Its "Ore." By C. W. Davis.

U. S. Coast and Geodetic Survey: Triangulation in Maryland.

Smithsonian Institution:
  Annual Report for 1924.
  Report on the International Exchange Service for 1925.

National Research Council: Researches in Sedimentation in 1924.

U. S. Army: Annual Report of the Chief of Engineers, 1925.

Federal Power Commission: Fifth Annual Report, 1925.

Mint: Annual Report of the Director, 1925.

U. S. Department of Commerce: Annual Report of the Director, U. S. Coast and Geodetic Survey for the Fiscal Year ended June 30, 1925.

Alberta, Scientific and Industrial Research Council of—Report 14. Analyses of Alberta Coal.

Argentina, Ministerio de Agricultura de la Nacion:
  Publication 5—Memoria de la Direccion General de Minas.
  Publication 6—Informe sobre la Existencia de Mineral de Hierro en Los Alrededores Mayires de Potrerillos y Cachueta en la Provincia de Mendoza. By Roberto Beder.
  Publication 7—Sobre los Rasgos Principales de la Glaciacion Actual en la Isla Laurie-Augusto Tapia.
  Publication 8—Sobre la Esructura Tectonica de las Capas Petrolifer as en el Oriente del Territorio del Nauquen. By J. Keidel.
  Publication 9—Memoria de la Direccion General de Minas en 1923.
  Publication 10—Informe Geologico Preliminar sobre el Yacimiento de Magnetita de la Mina "Sarmeinto" Region de Characate Sierra de Cordoba.
  Publication 11—Algunas Observaciones sobre el Yacimiento de Mineral de Hierro de la Mina "Romay" cerca de Albigasta, Provincia de Catamarca.

Great Britain Geological Survey:
  Geological Sheets:
    Romford.
    Marlborough.
    Map of the British Isles.
    Scotland.
    Vertical Section Sheet.
  The Geology of the Country around Birmingham.
  The Geology of the Country around Romford.

Scotland Geological Survey:
  The Geology of the Country around Golspie, Sutherlandshire. By H. H. Read.
  Economic Geology of the Ayrshire Coalfields, Area I—Dalry Saltcoats, Kilwinning and Kilmaurs. Area II—Kilmarnock Basin.
  The Geology of the Glasgow District.

South Australia:
  Annual Report of the Director of Mines and Government Geologist for 1924.
  Department of Mines: No. 42—Mining Review of the year ended June 30, 1925.

Transvaal Chamber of Mines: 35th Annual Report, 1924.

Transvaal Economic Wage Commission:
  Statement 1—Evidence of the Gold Producer's Committee of the Transvaal Chamber of Mines.
  Statement 2—The Procedure by Which Wage Rates Are Settled and the Influence of Public Wage Regulation Upon Industrial Development.
  Statement 3—The Terms of Reference to the Commission.
  Statement 4—The Effect of Wage Rates Upon the Distribution of Labour Between Different Occupations.
  Statement 5—To Consider the Effect of Different Wage and Labour Policies Upon the Opportunities at a Wage Compatible With a Civilized Standard of Life.

American Institute of Mining and Metallurgical Engineers:
  Transactions Vol. LXXI.
  Transactions Vol. LXXII.

Australian Museum, Records of the—Vol. XIV, No. 4.

British Museum:
Guide to the Fossil Plants in the Department of Geology and Palaeontology.
An Introduction to the Study of Minerals.

California Academy of Sciences: Vol. XIV, Nos. 1 to 17.
International Geological Congress: XIV Session Spain 1926.
Mining and Metallurgical Society of America:
Bulletin 179—Annual Business Meeting of New York Section.
Bulletins 180 and 181.

Illinois State Geological Survey:
Report of Investigations No. 6—Proper Testing for Oil Structures in Illinois and Some Areas Deserving Such Testing. By G. F. Moulton.
Report of Investigations No. 7—Further Contributions to the Geology of the Allendale Oil Field. By Gail F. Moulton.
Bulletin 29—Coal Resources of District 3 (Western Illinois).
Bulletin 30—Coal Losses in Illinois. By C. A. Allen.

Kansas State Geological Survey: Bulletin 10—The Geology of Russell County. By W. W. Ruby.

Kentucky Geological Survey:
Agricultural perspective of Kentucky Geology. By W. R. Jillson.
Series XI, Vol. 24—Geography of the Western Coal Fields. By W. G. Burroughs.

Nebraska State Museum: Bulletin 9—Tetrabelodon Abeli. By E. H. Barbour.
New Jersey Department of Conservation and Development: Bulletin 27—The Mineral Industry of New Jersey for 1924.
Ohio Geological Survey: 4th Series, Bulletin No. 29—Industrial Water Supplies of Ohio. By C. W. Foulk.

Oklahoma Geological Survey:
Bulletin 34—Geology of Cimarron County, Oklahoma. By E. P. Rothrock.
Bulletin 35—Index to the Stratigraphy of Oklahoma. By C. N. Gould.

Pennsylvania Topographic and Geologic Survey:
Bulletin M6, Part 4—Bituminous Coal Fields of Pennsylvainia.
Bulletin M7—Limestones of Pennsylvania.

Pennsylvania Department of Forests and Waters: Bulletin M8—Anthracite losses and Reserves in Pennsylvania. By D. C. Ashmead.
Philippine Islands Bureau of Science: The Mineral Resources of the Philippine Islands for the years 1921, 1922 and 1923.

South Dakota Geological and Natural History Survey:
Circular 21—Sand and Gravel Deposits of Yankton County. By E. P. Rothrock.
Circular 24—The Ragged Butte Structure. By Roy A. Wilson.
Circular 18—Well Log in Northern Ziebach County. By W. L. Russell.
Circular 27—The Structure of Western South Dakota. By F. Ward.

Virginia Geological Survey: Bulletin XXVI—The Geology and Coal Resources of Lee County, Virginia. By A. W. Giles.

Wisconsin Geological Survey:
Bulletin 57—Phytoplankton of the Inland Lakes of Wisconsin. By G. M. Smith.
Bulletin 65—The Geography of Southwestern Wisconsin. By W. O. Blanchard.
Bulletin 66—Limestones and Marls of Wisconsin. By Edward Steitman.
Bulletin 67—A brief outline of the Geology, Physical Geography, Geography and Industries of Wisconsin. By W. O. Hotchkiss.

California, University of—Geology Departemnt: Vol. 16, No. 1—Morphologic Features of the Basin Range District in the Great Basin. By George D. Louderback.

Kansas, University of: Engineering Bulletin No. 13—Kansas Coal. By C. M. Young.

Minnesota, University of: Bulletin 10—Ball Mill Crushing in Closed Circuit With Screens. By W. E. Davis.

Missouri, University of: Bibliography on zinc retorts and condensers. By B. M. O'Harra.

Pennsylvania State College:
  Bulletin 33—An Investigation of Certain Methods for Testing Heat Insulators. By E. F. Grundorfer.
  Bulletin 34—Tests of Household Fuel Savers and the Economical Use of Coal. By F. G. Hechler.

Maps.

Topographic Maps:
  Burbank, California.
  Paige, California.
  Remnoy, California.
  Visalia, California.
  Covelo, California.
  Riverdale, California.
  Burrel, California.
  Traver, California.
  Laton, California.
  Monson, California.
  Exeter, California.
  Cairns Corner, California.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Bulletin, Union Oil Co., Los Angeles.
California Journal of Development, San Francisco.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical Engineering and Mining Review, London, England.
Engineering and Mining Journal-Press, New York.
Explosives Engineer, Wilmington, Del.
Financial Insurance News, Los Angeles, California.
Graphite, Jersey City.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mine and Quarry, Chicago.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil and Gas News, Kansas City.
Oil News, Galesburg, Illinois.
Oildom, New York.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, San Francisco, Cal.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of Mining in California was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of Mining in California, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

41–1 Consulting work. Power cost, rate and schedule problems; design, specifications, estimating and reports.

41–2 Technical Librarian. Late technical librarian, Central Mining Rand Mines, Ltd., Johannesburg.

41–3 Mining Engineer. Leaching ores especially. Four and one-half years' experience. Age 30. Single.

41–4 Company Physician and Surgeon. Graduate Cooper Medical School. Fourteen years' experience. Prefer southwest.

41–5 Coal Mine Manager. Developing coal mines. Twenty-five years' experience.

41–6 Mine Superintendent. Long and varied experience. Age 49. Married. References.

41–7 Underground Foreman. Fifteen years' foreign experience. Age 44. Married. References.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; Sun Finance Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper	----
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----
Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	3.75
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly, January, April, July, October, 1925, per copy	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924	Free
January, February, March, April, May, June, July, August, September, October, 1925	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps	$0.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905. 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	$0.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted	2.50
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring, 1918. 248 pp., 51 illustrations, 5 maps, paper	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley, 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth	1.00
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916–1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917–1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	----
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth	1.00
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley, 1923. 188 pp., paper	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley, 1924. 162 pp., paper	Free
Bulletin No. 95. Geology and Ore Deposits of the Randsburg Quadrangle, by Carlton D. Hulin, 1925. 152 pp., 49 photographs, 13 line cuts, 1 colored geologic map, cloth	2.00
Bulletin No. 96. California Mineral Production for 1924, by Walter W. Bradley, 1925. 173 pp., paper	Free

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.	Price
**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	----
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
**Preliminary Report No. 8. A Review of Mining in Caifornia During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----

MAPS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County	$0.25
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County	----
Register of Oil Wells, with Map, Los Angeles City	----

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California, Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted	.50
**Unmounted	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	.25
**Map of Trinity County	----
**Map of Tuolumne County	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County	.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emido and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75

OIL FIELD MAPS—Continued.

	Price
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	$0.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	1.00
Map No. 30—Rosecrans, Los Angeles County	1.00
Map No. 31—Inglewood, Los Angeles County	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

O

43729 3-26 2750

THE STATE MINING BUREAU

CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE

MINERAL RESOURCES OF CALIFORNIA

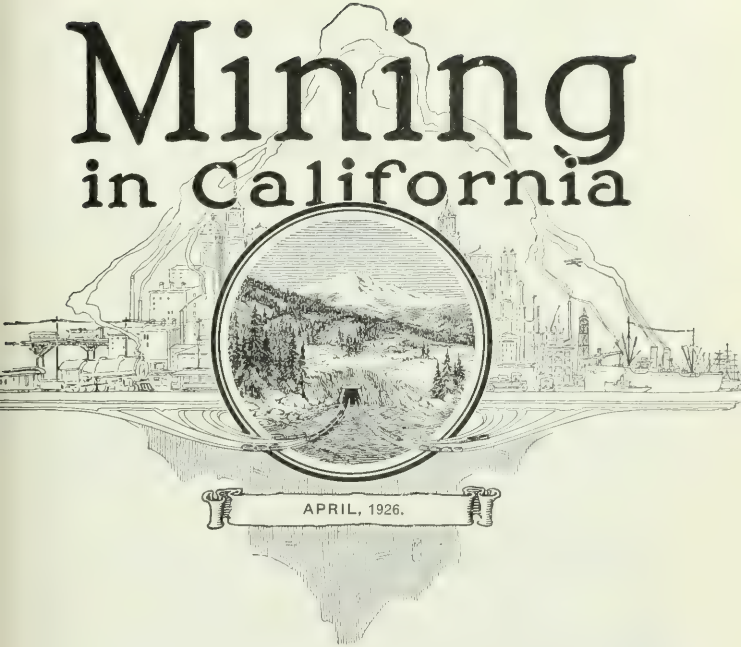
At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the state mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily
Saturday, 9 a.m. to 12 m.

Lloyd L. Root,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.
Branch Offices: New Orpheum Building, Los Angeles; Chamber of Commerce Building (mail address, P. O. Box 1208), Sacramento; Bank of Italy Building, Bakersfield; Taft, Coalinga, Santa Maria, and Santa Paula.

Mining
in California



APRIL, 1926.

PUBLISHED QUARTERLY

CALIFORNIA STATE
MINING BUREAU
FERRY BUILDING
SAN FRANCISCO

309

CALIFORNIA STATE MINING BUREAU

EXECUTIVE AND TECHNICAL STAFF

LLOYD L. ROOT
State Mineralogist

WALTER W. BRADLEY
Deputy State Mineralogist

MINING DIVISION

C. A. LOGAN, District Mining Engineer	Sacramento
C. McK. LAIZURE, District Mining Engineer	San Francisco
W. BURLING TUCKER, District Mining Engineer	Los Angeles
FRANK SANBORN, Mineral Technologist	San Francisco
W. F. DIETRICH, Ceramic Engineer	San Francisco

DEPARTMENT OF PETROLEUM AND GAS

R. D. BUSH, State Oil and Gas Supervisor	San Francisco

NOTE.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT State Mineralogist

Vol. 22 APRIL, 1926 No. 2

CHAPTER OF

REPORT XXII OF THE STATE MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1926

TABLE OF CONTENTS.

PAGE

DISTRICT REPORTS OF MINING ENGINEERS 121

Sacramento Field Division 121
  Shasta County 121

San Francisco Field Division 217
  San Benito County 217

Los Angeles Field Division 248
  Imperial County 248

Oil Field Development Operations 286

SPECIAL ARTICLES

The Federal Revenue Act and The Mining Industry 292

ADMINISTRATION DIVISION 298

DIVISION OF MINERALS AND STATISTICS 299

Statistics 299

Museum 304

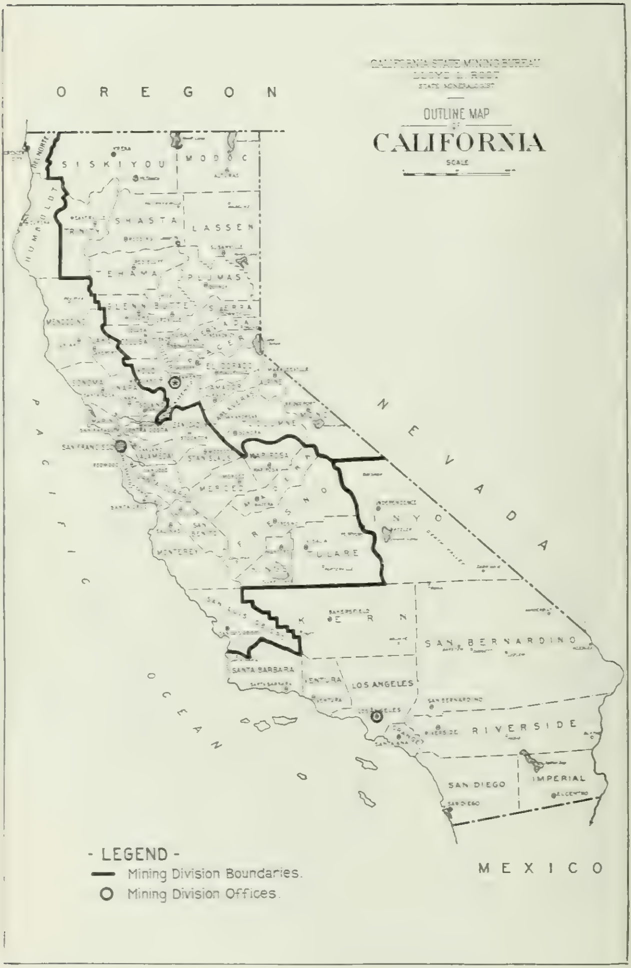
Laboratory 305

LIBRARY 306

PRODUCERS AND CONSUMERS 311

EMPLOYMENT SERVICE 312

BULLETIN PUBLICATIONS I


CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
NEVADA
MEXICO
PACIFIC
OCEAN
DEL NORTE
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
MENDOCINO
LAKE
COLUSA
YUBA
NEVADA
PLACER
SUTTER
YOLO
EL DORADO
ALPINE
SONOMA
NAPA
SOLANO
AMADOR
CALAVERAS
MARIN
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
MONO
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
SAN BENITO
FRESNO
INYO
MONTEREY
KINGS
TULARE
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
YREKA
SANTA ROSA
STOCKTON
SONORA
FRESNO
VISALIA
INDEPENDENCE
BAKERSFIELD
SANTA BARBARA
VENTURA
LOS ANGELES
SANTA ANA
SAN BERNARDINO
RIVERSIDE
SAN DIEGO
EL CENTRO
DEATH VALLEY
- LEGEND -
Mining Division Boundaries.
Mining Division Offices.

PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

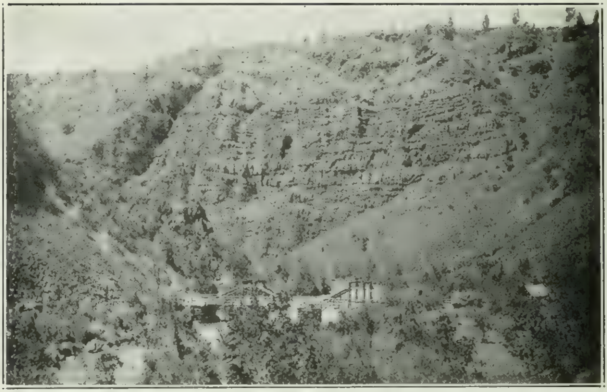
Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.



Canyon of Pit River, fifteen miles northeast of Cassel, Shasta County.
Photo by H. Williams, Cassel.

Diatomite deposit at Warner Bridge on Pit River, near Burney.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

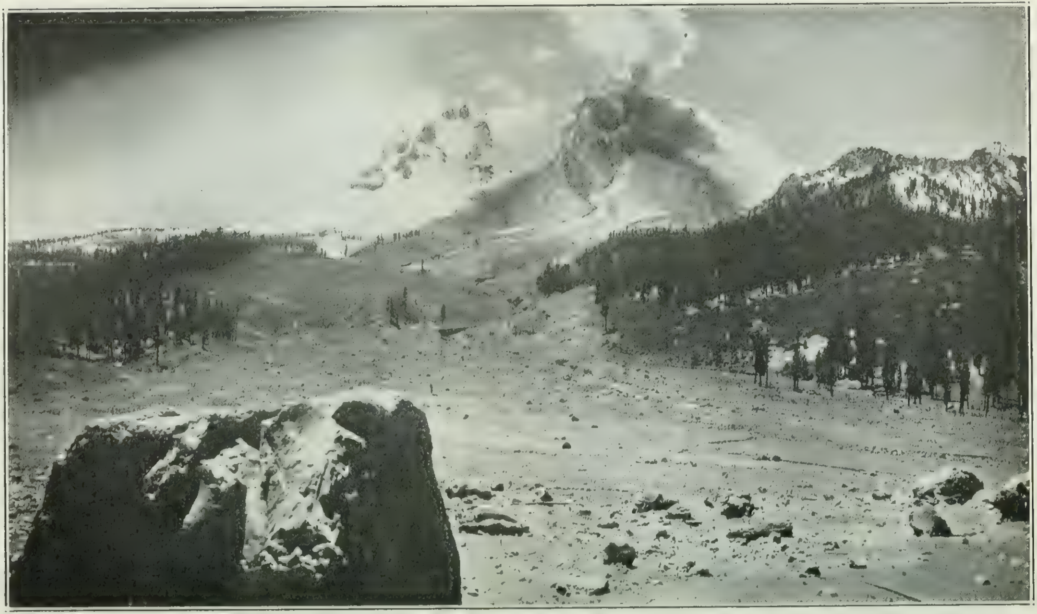
SACRAMENTO FIELD DIVISION.

C. A. Logan, Mining Engineer.

SHASTA COUNTY.

Geography.

This county lies at the northern end of the Great Central Valley of California. Redding, the county seat, is 175 miles north of Sacramento, and is the principal railroad and supply point for Shasta and Trinity counties. The Pacific Highway traverses the valley, connecting Oregon and California cities. It is an excellent concrete road to a point north of Redding, and from there to the state line is now being completed on a series of easy grades and under specifications that make it one of the most attractive scenic routes in the state. From this highway



Effect of the eruption of Lassen Peak, May 19, 1915, on the head of Hat Creek, Shasta County, California. (No. 1 in series of three.) This view endured for a period of less than three days. Photo by B. F. Loomis. Furnished by courtesy of M. E. Dittmar.

good branch roads lead to all the mining districts of the county, and due to the generally mild climate are passable all the year for autos. The Oregon line of the Southern Pacific Railroad gives the county rail connection with California points on the west and south and Oregon and other states to the north and northeast, following the canyon of Sacramento River north of Redding.

Shasta County has an area of 3858 square miles and in 1920 had a population of 13,311, most of whom live in the valley regions contiguous to Sacramento River. The river leaves its mountainous canyon near Redding and south of there flows through an open and rolling country devoted to farming. The mineral deposits are confined to the western half of the county. Most of the eastern half is covered by volcanic rocks. To the west and northwest ranges of the Klamath Mountains separate Shasta from Trinity and Siskiyou counties. Lassen, Modoc and eastern Siskiyou counties on the north and east, as well as eastern Shasta, are covered by comparatively recent volcanic flows and the elevation of this lava field rises steadily as one travels eastward, until the high mountain peaks are reached.

Lassen Peak, the only active volcano in the continental United States, is in the southeastern corner of Shasta County. This volcano became active May 30, 1914, with a series of steam explosions which threw stones over an area of a mile square and ejected volcanic ash which was carried quite a distance by the wind. On June 14 of the same year, two new craters were opened on the mountain a mile from the main crater. This was accompanied by a shower of ash and stones, and the emission of much smoke. Many times since then, vapor has been observed issuing from the mountain, especially during the spring and early summer, when the snow is melting. The last activity noted was during the past month (March, 1926). Lassen National Park has been set aside by the government. It embraces Lassen Peak and the nearby area, in which are still to be seen numerous signs of volcanic activity, such as hot springs, boiling mud pools and recent small sulphur deposits. The last real lava flow in the United States came from Lassen Peak in 1915, according to M. E. Dittmar.[1] The last previous flow, from the Cinder Cone, on the Lassen County line, is placed by Dittmar 130 years ago but Diller[2] placed it 200 years ago.

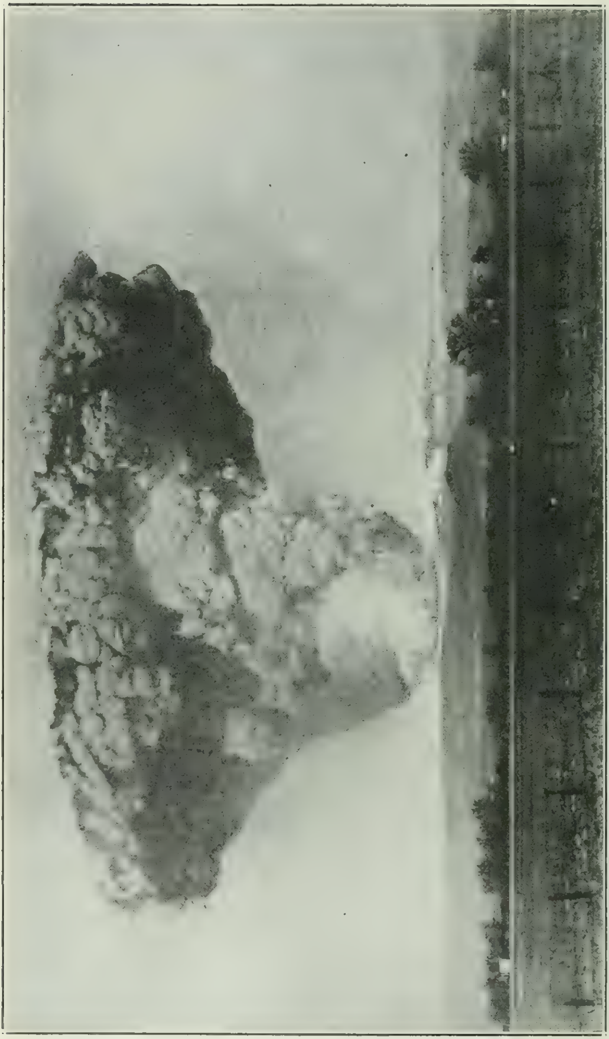
Mineral Resources.

Shasta County is distinguished by the variety and complexity of its geologic formations and the great diversity of its mineral resources. The principal free-gold quartz mines are found in the Bragdon (Carboniferous) slates which extend for many miles along the Trinity-Shasta counties line from Deadwood through French Gulch and northward. While the gold production has been notable, exceeding a total of $30,000,000 since 1880, this branch of the industry has been quiet and production has fallen off since 1916. The quartz mines in the Shasta, Whiskeytown, Old Diggins and adjacent districts, between the railroad and the western slate belt, carry mostly base, and often low-grade ores, with one-half or more of the gold in the sulphides, so that smelting is required. These mines were advantageously operated while the copper smelters were in commission, as the quartz was in

---

[1] Secretary, Lassen Volcanic National Park Association.

[2] Diller, J. S., Geologist, U. S. Geological Survey.



No. 2. The final great cataclysmic eruption of Lassen Peak, May 22, 1915. Taken from point on the Southern Pacific railroad about 40 miles to the west, Shasta County, California. Photo by B. F. Loomis, Viola. Furnished by courtesy of M. E. Dittmar.

demand for flux. Harrison Gulch district, in the southwestern corner of the county, had one notable quartz mine, the Midas, which produced very rich free-milling ore. This proprty is expectd to be reopened soon.

Placer mining production in recent years has been principally from two gold dredgers, one on Cottonwood Creek along the southern county line, and one on Clear Creek southwest of Redding.

Silver has been produced as a by-product of copper and gold mining, but the county also had a district of distinctly silver-bearing ores, 2½ to 4 miles northwest of Igo. None of the mines in this district are active.

The county has been chiefly known as a producer of copper. Production of this metal began in 1896, and until 1920 Shasta led all the other counties in this item, which in value often exceeded the gold output of the important quartz mining counties to the south. While the peak of copper production appears to have been passed, and the smelters are idle or being dismantled, there are still important copper orebodies unworked. With increased depth in some of the copper mines it was found that the amount of zinc in the ores was increasing to the point where zinc sulphide predominated and copper became subordinate. Attention is now being given to the zinc ores, which are mined at Ingot and Bully Hill and concentrated at the latter place.

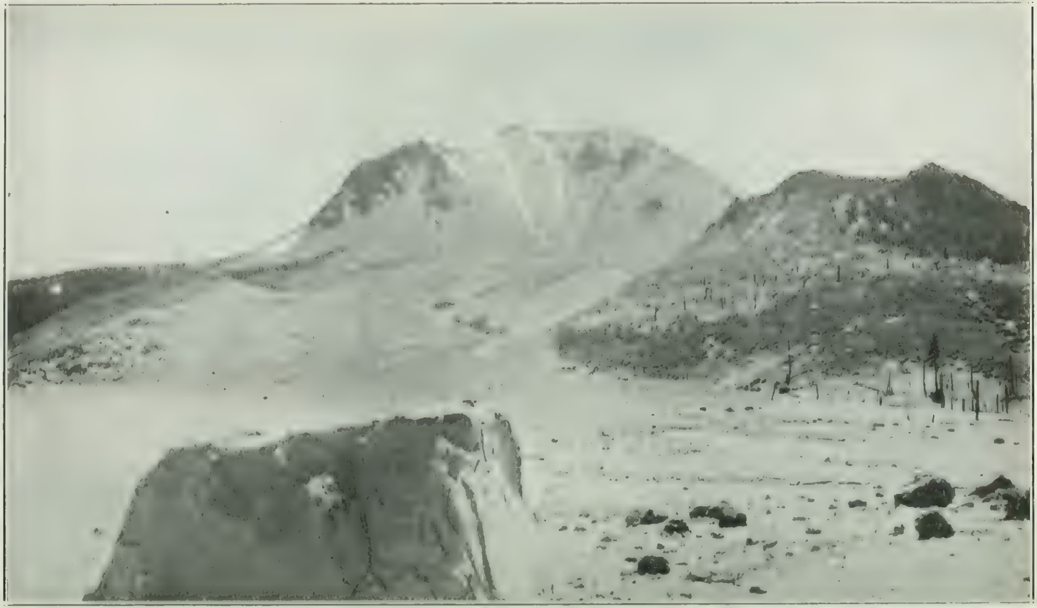
Pyrite has also come to be an important product, the Hornet Mine steadily producing a larger tonnage than any other pyrite mine in the state. From 1894 to 1918, Shasta County was an important producer of chromite, having at the Little Castle Creek Mine the largest body of this ore yet found in the west.

The iron ore resources are notable, and the deposit near Heroult continued the production of good grade ore which was used at Pacific coast plants until the mine was closed about a year ago. Here the Noble Electric Steel Company worked out successful methods for the electric smelting of iron and the production of ferro-silicon and ferro-manganese was carried on during the late war. Cadmium, platinum, molybdenum and lead have also been produced in small quantities from the county.

Among the nonmetallic minerals, the most important are the immense beds of limestone, exceeding in quantity those of any other county in the state. These deposits are in large part near enough to the railroad to be cheaply available for cement, with suitable shale beds nearby. Development of the mineral to date has been on a small scale only, for use at smelters chiefly, and no kilns are now in operation.

Of great interest as a possible future source of fuel, are the extensive beds of black lignite found in the central part of the county. These beds are being prospected, and the lignite is known to occur for a length of 12 miles or more. Proper methods of treatment may lead to the successful production of powdered fuel.

Large and valuable deposits of asbestos, brick clay, barytes, miscellaneous stone, talc, and diatomaceous earth are found and most of these are being prospected at present. Tuff, sandstone and other stones suitable for building occur. The diatomaceous earth deposit along Pit River at and below the junction of Hat Creek in the northeastern part of the county is an example of the only important class of deposit within the great sheet of later lava.

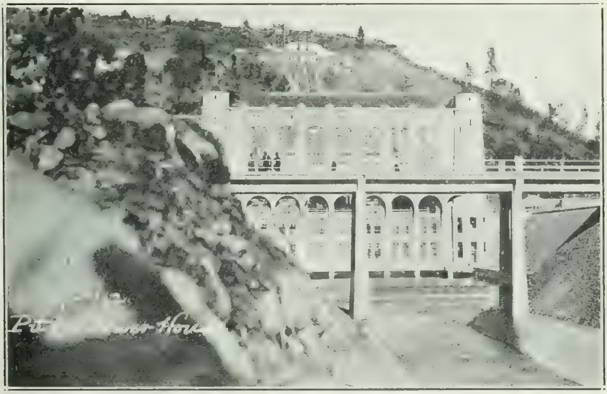


No. 3. The devastated area at the head of Hat and Lost creeks after the final great eruption of Lassen Peak, and as it now appears. From same point of view as shown in No. 1. Note the stumps of trees (seen on right and left lower slopes) whose tops were sheared off by the terrific force of the final volcanic blast. Photo by B. F. Loomis, Viola. Furnished by courtesy of M. E. Dittmar.

Power.

The vast lava beds of northeastern California form a remarkable underground reservoir from which Pit River draws a nearly uniform volume of water throughout the year, with less seasonal variation of flow than in any other important stream in the state. The river also has sufficient grade, and numerous sites in its canyon are favorable for the building of high dams, so that it is peculiarly attractive as a source of hydroelectric power. The Pit River development program of Pacific Gas and Electric Company, which is partly completed, is one of the most important projects of the kind ever undertaken, as regards magnitude and cost, the length of transmission lines and voltage employed.

Two power houses, called Pit 1 and Pit 3 (see photos and map) are in commission, the construction work for a third is under way and several others are planned. High-tension steel tower lines transmit electricity under a potential of 220,000 volts from each of these generating stations to a newly erected station near Vacaville, where the voltage is stepped down and electricity is distributed to many cities around San Francisco bay as well as farther inland.



Pit No. 1 Power House of Pacific Gas and Electric Company on Pit River, Shasta County. Photo by H. Williams, Cassel.

Electric power lines serve all the mining districts of the county, and large consumers enjoy low rates.

Timber.

Both the eastern and western parts of the county are covered by good sized timber, as is also part of the upper canyon of the Sacramento, although the last named section has been largely cut over because of its accessibility. The lowland country near the river, and the copper mining districts, support only scrub growth. Northeastern Shasta

County, from the vicinity of Round Mountain northeastward, and contiguous to the Alturas highway, has one of the finest stands of virgin timber in the state.

Transportation.

The large copper mines operated their own tramways and railroads to connect with the Southern Pacific main line. Sacramento Valley and Eastern Railway from Pit on the main line to Winthrop serves the Heroult and Copper City districts as well as the mines at Bully Hill. From Sisson on the main line the McCloud River Railroad runs 36 miles east to Bartle. From this point Pacific Gas and Electric Company's Pit River railroad runs about 30 miles to the site of their power developments on Pit River giving an outlet for the immense diatomaceous earth deposits in that section.

Pit No. 3 dam from upstream. On Pit River near Burney, Shasta County.
Photo by H. Williams, Cassel.

ASBESTOS.

Chrysotile and amphibole asbestos of good quality have been known for years and have been described in past reports of this bureau, dealing with Shasta County. The deposits are from three to seven miles north and northwest of Sims in Townships 37 and 38 North, Ranges 4 and 5 West, in the northwestern part of the county. Development has been slow and only a little production has been recorded.

Anaconda Prospect is in Sec. 6, T. 37 N., R. 4 W., four miles north of Sims.

D. E. Miles Prospect is in Sec. 36, T. 38 N., R. 5 W., five miles north of Sims.

Stock Asbestos Mines (formerly Stock & Stevens) are in Secs. 1, 2, 3, and 4, T. 37 N., R. 5 W., and Secs. 33 and 34, T. 38 N., R. 5 W., from three to six miles northwest of Sims and at an elevation of 3500 to 6300 feet. Mears Creek flows through the claims. Owner,

SHASTA COUNTY, 1880-1925.

Year	Brick		Chromite		Copper		Gold, value	Lime		Limestone		Mineral water		Pyrites		Silver, value	Miscellaneous and unapportioned		
	M.	Value	Tons	Value	Pounds	Value		Barrels	Value	Tons	Value	Gallons	Value	Tons	Value		Amount	Value	Substance
1880							$140,455									$117,907			
1881							350,000									85,000			
1882							300,000									80,000			
1883							210,000									20,000			
1884							320,000									30,000			
1885							417,004									9,223			
1886							699,508									10,647			
1887							627,681									40,201			
1888							600,000									50,000			
1889							415,631									5,396			
1890							420,530									7,279			
1891							554,063									7,432			
1892							574,833									7,077			
1893							500,407									8,577			
1894			1,200	$16,800			617,436					150,000	$75,000			5,032	200 tons	$1,500	Iron ore.
1895			90	1,120			718,696									28,417			
1896	300	$1,500			1,847,087	$184,708	599,200	2,310	$2,541							24,233		1,400	Stone industry.
1897	1,200	7,200			13,592,610	1,535,966	569,071	2,100	2,100	9,000	$13,500					90,860			
1898	1,200	7,200			21,442,000	2,465,830	800,180	2,500	3,750			3,000	2,000			171,768			
1899	2,000	14,000			21,835,363	3,565,023	873,710	8,000	10,000	250	375	5,000	1,850			196,213	100 sq'rs	800 375	Slate. Stone industry.
1900	2,000	12,000	140	1,400	25,736,473	4,166,735	733,467	17,850	17,850	1,150	1,150	9,640	5,784			635,640			
1901	3,000	12,000	130	1,950	30,900,781	4,881,048	927,975	21,600	12,960			26,295	7,644			891,994		2,000	Stone industry.
1902	2,450	12,250	315	4,275	21,515,887	2,490,731	878,706	18,500	12,500	3,500	3,600	26,205	7,645	3,202	$7,005	306,857			
1903	3,500	17,500	150	2,250	16,453,409	2,171,497	771,242	27,000	10,800	5,400	5,400	40,000	12,000	2,500	5,500	203,991		1,500	Stone industry.
1904	3,000	15,000	98	1,470	26,438,145	3,439,974	1,031,429	18,000	10,500							399,660		47,723	Unapportioned, 1900-1909.
1905	3,500	14,000	20	300	10,830,865	1,688,614	684,952	10,700	8,000	3,600	3,600	80,000	12,000			167,548			
1906	4,400	22,000	80	1,200	22,477,304	4,338,121	819,144	12,860	8,040	27,000	32,960			32,689	89,895	434,483			
1907	4,500	33,000	260	5,200	27,844,364	5,568,873	791,997	29,222	31,900	30,761	30,761			65,788	197,364	370,211	400 tons	400	Iron ore.
1908	2,000	12,000	280	5,600	34,878,677	4,642,976	1,131,832	11,818	9,100	80,000	80,000	100,000	20,000	93,677	539,553	517,596		25,000	Stone industry.
1909	3,500	23,500	205	3,517	58,665,447	7,581,115	1,600,480	8,650	8,000	120,560	134,595	100,000	20,000	449,762	1,349,286	735,460	108 tons	174 4,688	Iron ore. Stone industry.
1910	2,425	17,548	680	9,155	44,947,950	5,725,469	1,533,728	16,616	14,114	117,109	117,083	40,000	10,000	31,683	126,602	648,905	579 tons 1,859 lbs.	900 83	Iron ore. Lead.
1911	2,825	20,094	875	13,697	29,539,913	3,692,489	[1]1,059,881	13,271	10,164	67,924	65,253	25,000	6,250	47,885	151,602	386,991	881 lbs.	40	Lead.
1912	1,697	10,195	1,000	8,000	25,249,892	4,166,232	986,803	6,529	3,548	58,022	45,575	23,225	5,046	62,605	174,402	425,382			
1913	300	4,330	280	2,800	27,680,436	4,291,708	1,208,870	8,595	7,030	41,346	35,616	30,000	6,850	72,071	194,409	448,031	47 tons 19,070 lbs.	1,175 849 10,686	Asbestos. Lead. Other minerals.
1914	1,504	10,223	807	4,884	25,122,766	3,341,328	1,101,202	8,057	5,163	36,997	30,026	30,000	6,850	69,438	195,362	346,706	1,436 tons 21,565 lbs.	5,128 841 125	Iron ore. Lead. Miscellaneous stone.
1915	1,836	11,550	1,757	17,570	30,828,917	5,395,060	1,120,848	[2]		44,953	40,945	12,000	1,800	[2]		450,566	180,936 lbs. 8,378,401 lbs.	8,504 1,418 1,038,922 253,950	Lead. Miscellaneous stone. Zinc. Iron ore, pyrites, lime.
1916	[2]		12,425	181,225	39,437,196	9,701,550	936,885	[2]		[2]		[2]		[2]		1,115,471	478,560 lbs. 9,484,800 lbs.	33,021 57,303 1,270,063 800 342,290	Lead. Lime and limestone. Zinc. Miscellaneous stone. Asbestos, brick, iron ore, manganese, mineral water, platinum, pyrites, silica.
1917	[2]		3,116	68,479	28,009,990	7,646,727	775,125	[2]		[2]		[2]		[2]		520,703	8,725 lbs. 14 ozs. 8,281,516 lbs.	750 78,101 1,100 800 844,715 308,369	Lead. Lime and limestone. Platinum. Miscellaneous stone. Zinc. Cadmium, brick, iron ore, mineral water, molybdenum, pyrites, silica.
1918	[2]		1,423	70,214	25,294,590	6,247,764	543,509			45,671	72,410			[2]		420,410	492,565 lbs. 35 ozs. 3,045,692 lbs.	34,972 2,709 7,000 277,158 422,525	Lead. Platinum. Miscellaneous stone. Zinc. Cadmium, brick, iron ore, lime, mineral water molybdenum, pyrites.
1919	[2]				8,673,342	1,613,242	378,283	[2]		[2]		[2]		138,046	497,398	165,802	121 fine ozs.	29,100 21,075 31,750 40,153	Lime and limestone. Platinum. Miscellaneous stone. Barytes, brick, iron ore, lead, mineral water, zinc
1920	[2]				810,843	149,195	312,901							135,399	475,330	36,563	64,400 lbs. 158 fine ozs.	5,152 27,004 32,650 69,743	Lead. Platinum. Miscellaneous stone. Asbestos, brick, iron ore, lime, limestone, zinc.
1921					437,593	56,449	267,681	[2]		[2]				[2]		5,581	219 fine ozs.	26,817 31,915 452,589	Platinum. Miscellaneous stone. Asbestos, barytes, iron ore, lead, pyrites, zinc
1922					1,827,875	246,763	393,034							[2]		26,901	496 fine ozs.	57,458 65,525 723,910	Platinum. Stone, miscellaneous. Asbestos, barytes, iron ore, lead, pyrites, zinc.
1923					3,437,963	505,381	350,487			[2]		[2]		[2]		47,706	328,115 lbs. 299 fine ozs.	22,968 43,326 86,500 498,010	Lead. Platinum. Stone, miscellaneous. Asbestos, barytes, iron ore, lime, limestone, pyrites.
1924					21,109,958	2,765,405	346,022			28,097	36,480			[2]		343,402	6,615 lbs. 27 fine ozs.	529 3,361 587,637 671,228	Lead. Platinum. Stone, miscellaneous. Asbestos, coal, diatomaceous earth, iron ore, pyrites, zinc.
Totals	47,287	$277,090	25,391	$421,106	646,961,136	$104,381,973	$31,064,515	244,778	$188,060	680,669	$676,919	700,455	$201,319	1,205,645	$4,003,708	$11,063,764		$8,019,186	

---

[1] Dredge production included under Stanislaus County.
[2] See under 'Unapportioned.'

H. E. Stock, Humboldt Bank Building, San Francisco. The original holdings covered 1100 acres.

The country rock is principally serpentine, with later dikes of diorite and gneiss. Extensive outcrops of chrysotile-bearing rock, without overburden, occur and several sites for quarries have been selected and some work done on them. A great deal of actinolite is also said to be found, as well as other forms of asbestos. Disagreements among the owners hindered development for many years.

Bibl: Cal. State Min. Bur. R. XIV, pp. 752–755.

BARIUM.

The ore 'barytes' is essentially barium sulphate (barite) usually containing from 5% to 15% of other minerals. Silica, calcite, iron oxide, copper and iron sulphides and small amounts of carbon are the commonest of these. Any mineral which will discolor the barite when ground is objectionable as the mineral is used most extensively as an inert filler in paints and as a constituent of lithopone where a pure white is desired. Calcite is also objectionable, even when white. The sulphides of metallic minerals are hard to separate mechanically from barite because of the nearly equal specific gravities. Numerous other uses for barite depend on its insolubility (and consequent inertness), high specific gravity, and chemical characteristics of many compounds prepared from it. It is used as an inert filler in rubber, paper, oilcloth and linoleum. Barium compounds made from it are used in pottery, in making rubber, battery plates and in several chemicals. For some of these uses the color is not a critical factor.

Many barytes deposits of California are sufficiently 'off-color' to require chemical treatment, although carrying only a small percentage of impurities. Such crude ore commands a lower price than 'white-grinding' ore. Witherite (barium carbonate) is much rarer in California than the sulphate. One plant has been operated at intervals during recent years in Oakland, treating California ores for use in lithopone. It has changed hands several times, and is expected to reopen soon after several years idleness. Another has lately been built at Modesto.

Barite occurs as a gangue mineral in the copper mines of Shasta County, and a few deposits have been noted in different parts of the county.

H. C. Austin operated a quarry on a deposit in Sec. 29, T. 34 N., R. 3 W., near Copper City several years ago and shipped ore to Oakland. This has been idle the past two years, and is said to be worked out.

Barite No. 1 and *No. 2 claims*. Mike Malone, Platina P. O., owner. These claims are reported to be on a prospect of witherite, so far found as float. They are on Beegum Creek near Platina, which is 41 miles by road from either Red Bluff or Redding.

Exposed Treasure No. 1 and *No. 2 claims* are in Sec. 33, T. 36 N., R. 1 W. Owners, C. A. Packwood and Alonzo Luce, 333 North Butte Street, Willows. The claims are 12 miles north of Montgomery Creek, which is 44 miles by road from Redding. A road passes within less than one-half mile of claims.

Packwood states that barytes outcrops at intervals for 3000 feet, with a width of four feet. Only assessment work, consisting of a few holes, has been done. A depth of 22 feet has been reached. Samples shown are dark gray, but apparently fair grade.

Loftus Barytes Prospect. Owners, Loftus and Sons, Castella. Lessee, Chemical & Pigments Company. It is in Sec. 18, T. 38 N., R. 3 W., on the headwaters of Tom Neal Creek, seven miles by trail from Castella and at an elevation of 5000 feet.

'Off-color' barytes is said to outcrop at intervals for one-half mile. H. C. Austin did some prospecting on the claims in 1923. Lately an Oakland firm has taken a lease and option and is prospecting and developing the ore. Two egg-shaped deposits are said to have been found, in limestone. Nearly three miles of tramway, with a difference in elevation of 3000 feet between terminals, would be required to deliver ore to railroad. Work so far has been shallow.

CADMIUM.

Cadmium occurs as greenockite in the copper-zinc ores of Shasta County.[1] Greenockite is rare, but found at times as a lemon yellow coating with resinous luster, on zincblende.

The only recorded production of cadmium from California was from the electrolytic zinc plant of the Mammoth Copper Company during 1917–18, where several thousand pounds of cadmium metal was produced. Cadmium sulphide is used for yellow paint pigment and coloring glass, and cadmium in making alloys of low-melting point and bronze wire. There is no production locally at present, although the zinc concentrate shipped abroad from Winthrop probably carries cadmium.

CHROMITE.

In the northwestern corner of Shasta County there is an area in which serpentine and basic igneous rocks more or less altered to serpentine occur abundantly. They are contained within the area mapped by Smith[2] as "Paleozoic metamorphics undifferentiated: including limestones, slates and associated igneous and metamorphic rocks of the Klamath Mountains," which extends from near Lamoine, northeasterly to and beyond Dunsmuir. Though this metamorphic area appears on both sides of the Sacramento River north of Gibson, no serpentine nor chromite have as yet been reported east of the river. From the northern end of this serpentine belt has come the second largest single lens of chromite thus far developed in the United States. From the Little Castle Creek mine on the creek of the same name near Dunsmuir, on the Shasta-Siskiyou County line, the records of the State Mining Bureau show that upwards of 15,000 tons of chromite were shipped from 1900 to the end of 1916. Much of the chromite in this district is massive and high grade, but some disseminated orebodies have been noted in at least one locality.

Other good sized orebodies, among the largest in the state, besides the Little Castle Creek deposit, were worked. These were on the Shot-gun Creek claims of Noble Electric Steel Company near Sims, and the Forest Queen and Gray Eagle groups of claims.

---

[1] Eakle, A. S., Cal. State Min. Bur. Bull. 91, p. 47.

[2] Smith, J. P., Geological map of California, accompanying The geologic formations of California: Cal. State Min. Bur. Bull. No. 72, p. 9, 1916

These and numerous other properties were mentioned in our Bulletin 76, published in 1918. While Shasta County had been producing chromite for nearly 20 years previous to the world war for use at smelters, the principal production was during 1916, when under the stimulation of war demand and high prices, nearly one-half of the county's total production of 25,391 tons was made. Since the close of the war there has been little demand for chromite on the Pacific coast, and little production is recorded from this county since 1918. While the main orebody of the largest producer, the Little Castle Creek Mine, is worked out, other properties still contain ore.

Don Noble, Platina, reported the sale of two carloads, or about 100 tons ranging from 40% to 54% Cr_2O_3, from the Beegum district in 1925.

Bibl: Cal. State Min. Bur. Bull. 76, pp. 181–88, 222.

CLAY.

Clay suitable for making common brick occurs abundantly in the county in the flood plain of Sacramento River south of Redding, and along numerous other streams more remote from the railroad. A brick plant was formerly operated at Anderson but has been idle for many years. A little clay found as gouge or selvage with the orebodies in the copper mines has been used for lining copper converters, particularly at Bully Hill.

No clay products have been made in the county since the Anderson brick plant quit operation. This property had its own clay bed nearby, and supplied the northern part of the valley. The large brick kiln with a capacity of 40,000 brick in 7 hours and with a stack 120 feet high, still stands and is outwardly in good condition but there is no machinery. This property contained a clay deposit 15 feet thick.

Other clay deposits near transportation are:

Block 29, Redding Grant, 1¼ miles south of Redding. Clay bed six feet thick. A brick kiln was operated here many years ago. Idle for a long time.

Sec. 34, T. 34 N., R. 5 W. A deposit of fire-clay was formerly operated here by Holt & Gregg. Idle.

Redding Brick & Tile Company formerly operated a deposit on 40 acres in Sec. 19, T. 31 N., R. 5 W. and made brick in a small kiln at Redding. Idle for many years.

Redding Homestead Deposit is on the Sacramento River east of Cottonwood. Deposit is a mile long by one-fourth mile wide and contains 30 feet of clay, covered by 15 feet of sand and gravel. Idle and undeveloped.

Southern Pacific Company owns an undeveloped clay deposit in Sec. 19, T. 32 N., R. 4 W.

Bibl: Cal. State Min. Bur. R. XIV, p. 756; Bull. 38, p. 257.

COAL.

History.

That the lignite prospects of central Shasta County were known in 1863, and were being prospected as early as 1874, is shown by W. A. Goodyear's mention of the district in the Seventh Report of the State Mineralogist, pages 149 and 150. He described work that had been done apparently near the recent work on the Luce property, and gave a section of the coal bed. In 1876, when he again visited the place, work had been abandoned. He mentioned another tunnel, which had been driven nearby for a length of 400 to 500 feet. He also alluded to other coal outcrops which he noticed in Secs. 3, 7, 8 and 21, T. 33 N., R. 1 W., in Sec. 12, T. 33 N., R. 2 W., and elsewhere, none of which had been found up to that time to contain marketable coal.

In the same volume, Adolph H. Weber briefly described coal prospects in the SE¼ of Sec. 28, T. 33 N., R. 1 W., in the SE¼ of Sec. 29 adjoining, and in Secs. 1, 2, 3, 4 and 5, T. 33 N., R. 1 W. and in Secs. 32, 33 and 34, T. 34 N., R. 1 W. In 1876, a short tunnel was run on a coal prospect in Sec. 12, T. 33 N., R. 2 W. At about the same time, or during the ten years next following, coal prospects were found and some of them slightly prospected in the following places:

E½ of Sec. 11, and N½ of Sec. 14, T. 35 N., R. 1 W.
NE¼ of NE¼ of Sec. 32 and NW¼ of Sec. 33, T. 33 N., R. 1 W.
T. 37 N., R. 1 E., on Nelson Creek.
Sec. 24, T. 37 N., R. 1 W., on Kosk Creek, also near the head of the same creek.

None of these, so far as known, ever yielded coal in commercial quantities, and all of the prospects had lain idle for a long time when work was begun by P. B. Cross and associates on the Luce property in 1923.

Geology.

In central Shasta County the sedimentary rocks of the Chico (Cretaceous) and Ione (Tertiary) are overlain by the later Tuscan Tuff (late Tertiary) and still later basalt and cobbles. The lignite occurs mostly in the Ione, which is only about 50 feet thick in places but is much thicker elsewhere, reaching a thickness of 1000 feet on Kosk Creek. It is a series of rather soft, slightly consolidated sandstone, shale and conglomerate beds. The overlying basalt and cobble layer is about 30 feet thick in many places. At the Luce coal workings, where the beds appear to be undisturbed, the coal seams dip north and east at an angle of seven degrees. The roof of coal is soft sandstone and shale and the floor is shale. Diller in the Redding Folio of the U. S. Geological Survey describes the Ione formation and alludes to the difficulty of determining whether some of the beds lacking distinctive fossils are Ione or Cretaceous. In the Lassen Peak Folio, he places some of the coal seams of this region in the Chico (Cretaceous). As far as could be learned from G. H. Rees, superintendent in local charge of recent work, the present operators have had no determinations of fossils made, and are uncertain as to the age of formations in which they are working. Since the Ione beds lie so flat, and are comparatively thin, it is probable that the inclined shafts being sunk, will soon pass from the Ione into the Chico, if they have not already done so, as these shafts have a dip of about 45°. During the time when the Ione formation was deposited, an arm of the sea filled the Sacramento Valley, extending northeast through the region where the lignite occurs, but the water in this region is supposed to have been relatively fresh. Periods favorable to the deposition of lignitic material appear to have been interrupted by shorter periods when mud and sand were deposited, resulting in a series of beds of lignite alternating with thin partings of shale, each too narrow to be sorted out, but in the aggregate sufficient to lower the quality of the coal by the introduction of waste.

The lignite is mostly black and lustrous when first mined, and, in physical appearance, seems distinctly older than the brown lignite of the typical Ione beds, near the town of Ione, Amador County. While the Ione lignite often shows woody structure and even the bark of trees, and cracks and crumbles in a short time when exposed and dried, the best seams of lignite near Oak Run do not show these characteristics so distinctly, although it probably would not stand transportation well. In chemical analysis, there is little difference between them, both being low in fixed carbon and high in volatile matter, and the ash content of the Ione lignite is slightly lower if published analyses are accurate; but it carries more water than the Oak Run lignite.

Some of the prospecting work lately done has shown the coal beds considerably faulted. This faulting is probably due to earth movements connected with late activity of Lassen Peak and neighboring volcanic cones. The disturbed area is in the southern part of the district, in Secs. 3, 4, and 9, T. 32 N., R. 1 W., and Secs. 33 and 34, T. 33 N., R. 1 W.

Working Conditions, Transportation and Markets.

The deposits lie at elevations ranging from 1500 to 2000 feet. There is little snowfall, and operating conditions are good. Electric power is available and in use at some of the prospects. Timber is scarce nearby but available a little higher in the mountains. Palo Cedro, the nearest railroad point, is 15 to 20 miles from the prospects. The aerial tram from the Afterthought Mine to Winthrop, where coal could be loaded on railroad cars, is only a few miles from the Barnes and Dakin prospects. Roads are good except in places where they traverse the cobblestrewn areas of basalt. Grades are easy and in favor of traffic from the prospects toward the railroad. There is only a small and scattered population in the district or east of it and the only possible chance for a railroad would be one at some future date to exploit the large timber holdings to the east and northeast.

The lignite offers a cheap source of fuel for local use, but the present population of this section of the state is small. Sacramento, the nearest city of any size, is nearly 200 miles distant and has a population of about 100,000. The population of the Sacramento Valley north of Sacramento County was about 115,000 in 1920, and at least half of this, as well as the city of Sacramento, is so situated that it could be served more cheaply from the Amador County mines, should this type of fuel ever come into general use, although neither field has yet developed a coal that will stand shipment well without breaking up. It is probable that the population of the Sacramento Valley will increase immensely in the next few decades. It is also probable that the price of crude oil, locally at least, will increase to such an extent that it will soon be desirable to use some other source for the manufacture of gas. California lignite generally is high in volatile matter and it would be acceptable for such use. In this connection, it is interesting to note that Pacific Gas and Electric Company is now installing at their Marysville gas plant a new type of generator for making gas from coal, to work side by side with a generator using oil, in order to compare the relative costs of making gas by the two methods on a working scale. Tests of the Amador County lignite have shown it to yield a surprisingly high percentage of oil, under destructive distillation, besides a notable amount of ammonium sulphate. Powdered coal is also being adopted for fuel use, and would be of possibly great value for such a purpose as the manufacture of Portland cement which is sure to be undertaken at some future date in Shasta County where limestone occurs so abundantly. The Trent process or some similar method for the beneficiation of such coal, would, no doubt, reduce the waste and ash content of the Shasta lignite sufficiently to make it a very valuable fuel.

Recent Prospecting.

In 1923, Cross and Stevens began taking leases with options on land showing coal prospects in eastern Shasta County, and started work at the Lon Luce property with a few men. From time to time additional parcels of land were taken under royalty leases or options to purchase, until at present perhaps 15,000 acres are controlled extending from the vicinity of Clover Creek to Round Mountain. Prospecting operations have been carried on under the trusteeship of A. F. Hockenbeamer. John McNab and A. P. Cross of San Francisco. Late in May, 1926, these men incorporated as Mt. Shasta Coal Company. Nineteen men are employed under contract at three prospects (April, 1926). Griffith H. Rees, Lorenz Hotel, Redding, is in charge locally as superintendent. Results obtained so far at the principal openings are described below.

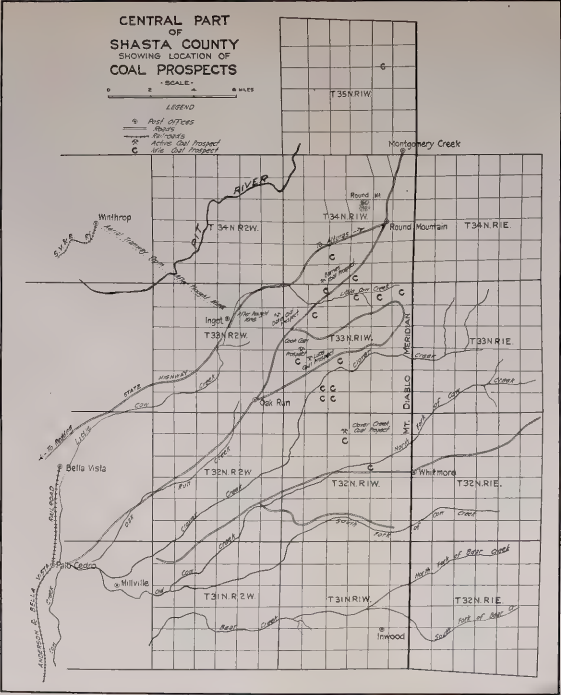
Barnes Prospect is on the Oscar Barnes ranch in SE¼ of SE¼ of Sec. 32, T. 34 N., R. 1 W., seven miles by road northeast of Ingot and at an elevation of 1740 feet.

An electric power-line, 5¾ miles long, has been built and a small hoist and compressor are in use. An incline, driven at the base of a lava-covered bluff, had reached a depth of about 200 feet on a 45° slope at time of visit, April 28. About one-half way down in this, two beds of coal occur on which 32 feet of drifting was done to take out a few tons for testing. The beds consist of alternating layers of coal, bone and clay. The coal seams vary in thickness from 2 to 22 inches with a total of about 67% of coal in the best section of 75 inches. The seams of bone and clay are mostly too narrow to permit sorting but according to G. H. Rees the total amount of such waste is sufficient to raise the ash content undesirably high.

After sampling the above beds, the incline was continued and at time of visit the sump showed black shale floor and grey clay shale roof. Rees believed this showed indications of nearness to another bed of coal.

The dip and strike of the coal beds on this property are about the same as at the Luce property, and the character of coal the same.

Clover Creek Prospect is on the N. B. Frisbie property in SE¼ of SE¼ of Sec. 4, T. 32 N., R. 1 W. Here the operators recently ran an adit 937 feet, N. 12° E., then sank an incline 164 feet on an angle of



CENTRAL PART
OF
SHASTA COUNTY
SHOWING LOCATION OF
COAL PROSPECTS

45°. According to Rees, this work was in a zone of faulting about one mile wide and three miles long in parts of Sections 3, 4 and 9, T. 32 N., R. 1 W., and Sections 33 and 34, T. 33 N., R. 1 W., where the line of faulting struck east and the south side of the area appeared to have dropped. The formations were so badly broken that no promising prospect was found and the work here has been stopped.

Cook Prospect is about three-fourths of a mile northwest of the Luce property, in Sections 18 and 19, T. 33 N., R. 1 W. An adit 180 feet long struck coal with a steep dip.

Dakin Prospect is in the SE¼ of NE¼ of Sec. 12, T. 33 N., R. 2 W., at an elevation of 1900 to 2000 feet. The lignite was prospected between 1874 and 1900 and an adit 350 feet long was run. The deposit shows coal seams separated by thin layers of clay, the total thickness being 14 feet or more. The coal seams in the old workings vary from 6 inches to 2½ feet in thickness and the greater part of the total width is coal. This property lay idle for about 25 years, without having made any commercial production. In 1924 the present operators began work and have a crew employed at present under contract. Results reported so far are similar to those described at the Barnes and Luce properties. Electric power is used and a small crew is employed sinking an incline.

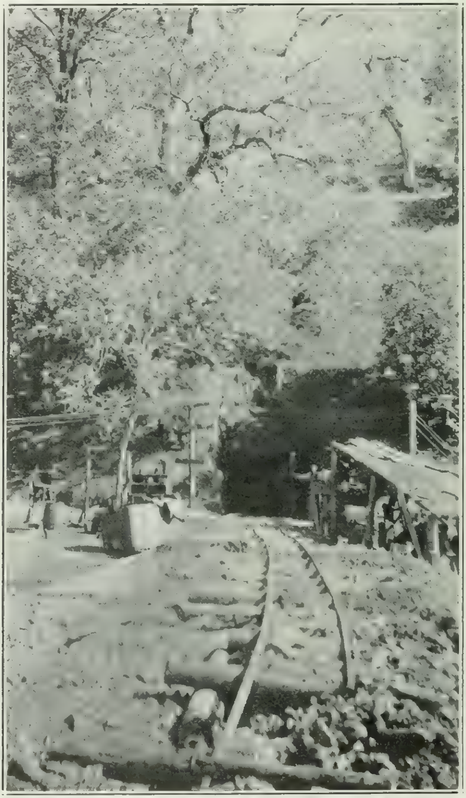
Luce Prospect is in the SW¼ of NW¼ of Sec. 20, T. 33 N., R. 1 W. at an elevation of 1675 feet about three miles by road northeast of Oak Run P. O. In 1923, work by the present operators began not far from where the first prospectors operated many years ago. By the summer of 1924, a flat incline, following the coal bed, had reached a length of 320 feet, from which point the work had been turned north and a drift run nearly 150 feet farther but without gaining any additional backs as the drift was approaching the surface because of the slope of hill. This opening showed five to six feet in width composed mostly of lustrous black lignite, but there are numerous narrow seams and partings of bone and clay between the coal layers, enough to seriously affect the quality of coal by raising the amount of waste that can not be disposed of by sorting and which shows in the ash content. Work on this bed has been suspended since 1924. The coal dips northeast about seven degrees.

Subsequent work has been in an inclined winze on a dip of 45°, sunk from the inside of the flat incline. Electric power is used to operate a hoist in this winze, and a mule hauls the loaded cars from the top of the winze to the portal of adit. There are also at this adit a small compressor and blower, and pump and gasoline engine. In sinking this winze another coal bed was cut at an inclined depth of 80 feet. This has a total thickness of five feet of which two feet appears to be fairly clean coal and the balance mixed seams of coal, clay and bone. Twelve feet lower in the winze another layer is said to show one foot of good coal with other minor seams. No further coal beds had been reported up to the time of visit in March, 1926.

Subsequently, Rees stated that the incline was sunk to a depth of 353 feet, where rhyolite was struck without finding any more coal. In the upper workings, mentioned in the first paragraph, a raise was put up early in April, 1926, and encountered an upper bed of coal, near the surface. This is now being prospected.

G. H. Rees gives the following as a general average analysis of the coal prospected in this region, under his supervision:

Fixed carbon (after drying)	42%
Volatile hydrocarbons (after drying)	33–35%
Ash (after drying)	23–25%
Sulphur (after drying)	.75–1%
B.t.u.s	9000
Moisture	17%



Portal of incline on Luce property, being prospected by Mt. Shasta Coal Company. Near Oak Run.

The accompanying map shows the location of coal prospects in central Shasta County, including those mentioned as having been worked 50 years ago, as well as those under lease or option to Cross and associates.

Work has also been done in the county on coal prospects on the upper course of Kosk Creek, and in the Beegum district in the southeastern part of the county.

Beegum Creek Deposit has been prospected by Don Noble, Platina, and D. F. Weed, Ono. It is in the W½ of Sec. 29 and E½ of Sec. 30, T. 29 N., R. 9 W., at an elevation of 2100 feet, 45 miles by road west of Red Bluff, and 4½ miles by road and trail from Platina. The discoverers ran an adit 80 feet, on the coal for about 40 feet, with three feet of coal at the face. A raise put up 20 feet shows layers of coal from a few inches to two feet thick.

The coal is said to be hard and good quality, and has been used a little locally for blacksmith work. The seam strikes east and dips 18° south and is said to outcrop at intervals for two miles beyond this property. There is some water nearby in Coal Gulch, a branch of Beegum Creek. The distance from railroad makes the possibility of commercial development doubtful.

Bibl: Cal. State Min. Bur. R. XVII, p. 515.

Frost Prospect. Owners, Byron Frost and wife, Willows. It is in Round Mountain District. Similar to others described. Idle.

Kosk Creek Deposits were prospected many years ago but were not producers, due to being in rugged country remote from railroads.

In the SE¼ of Sec. 22, T. 38 N., R. 1 E., at the old *Burckhalter Coal Prospect,* it is said that coal is exposed in the creek bed and along the banks for one-half mile. This is on one of the headwater branches of Kosk Creek, three miles south of the Siskiyou County line. While the writer did not visit the place Mr. C. O. Willis of Burney, who is familiar with the region, states the widest vein is 13 feet thick and that in all 23 seams of coal have been found here. Samples exhibited are black and apparently fair grade sub-bituminous (black lignite). The section of the widest vein is said to show the following:

roof, black and white sandstone
small seams coal
clay
7½ feet coal
2 feet clay
5½ feet coal

The deposit is about 10 miles from nearest point on present Pacific Gas and Electric Railway, but it is estimated 15 miles of railroad would be required to reach it on account of steep grades. It is at present accessible only by 14 miles of trail.

The *Scott Coal Prospect* is another showing three-fourths mile northwest of the last named, on another fork of the creek. It was prospected superficially years ago.

COPPER.[1]

By W. B. TUCKER, Mining Engineer.[2]

DESCRIPTION AND LOCATION OF COPPER DISTRICTS.

The copper region of Shasta County is about 30 miles in length and about 15 miles in width, extending nearly east and west across the Redding Quadrangle of the U. S. Geological Survey, and embraces three actively producing districts known as Iron Mountain, Bully Hill, and Ingot, which are separated by a dozen miles of country where as yet no large bodies of copper ore have been found.

The Iron Mountain district is the largest and by far the most important region. Iron Mountain lies just outside of the border of the Redding Quadrangle, northwest of the old town of Keswick, and from this locality the district extends nearly northeast for 25 miles to and beyond the Mammoth, and has a width of about two miles. It comprises the holdings of the Mountain Copper Company, Pittsburgh-Mount Shasta Mining Company, Balaklala, Trinity Copper Company, Colma Copper Company, Golinsky Copper, and a number of other smaller mines.

The Bully Hill district comprises an area scarcely three miles north and south by two miles east and west, and includes the Bully Hill, Rising Star, Arps, and Copper City lodes, besides a number of prospected claims on the south and southwest slope of Horse Mountain. (Plate I.)

The Ingot district, which is on the east end of the copper region, has an area of scarcely two miles north and south by three miles east and west, and includes the Afterthought, Donkey and Woodrow Wilson mines.

Geology. (Excerpts taken from Redding Folio, U. S. Geological Survey on geology of district.)

The country rock of the copper deposits is practically the same throughout the region, but not all the same age. It is chiefly rhyolite and tuff, and here and there a trace of included sediments.

Character of Ore Deposits. The copper ore deposits are lenses or zones of disturbance in which the country rock is crushed and sheared, thus producing the channels for circulating waters, and greatly enhancing the possibilities of the mineral solution and deposition.

Fissure Systems. The rocks of the copper region have experienced disturbances at many periods extending over a wide range of time. The system of fissures is confined to three groups: (1) The early fissures filled at least in part by igneous rocks of the pre-Cretaceous eruption, (2) the fissures bearing ore deposits, and (3) the fissures of the late Cretaceous or post-Cretaceous age.

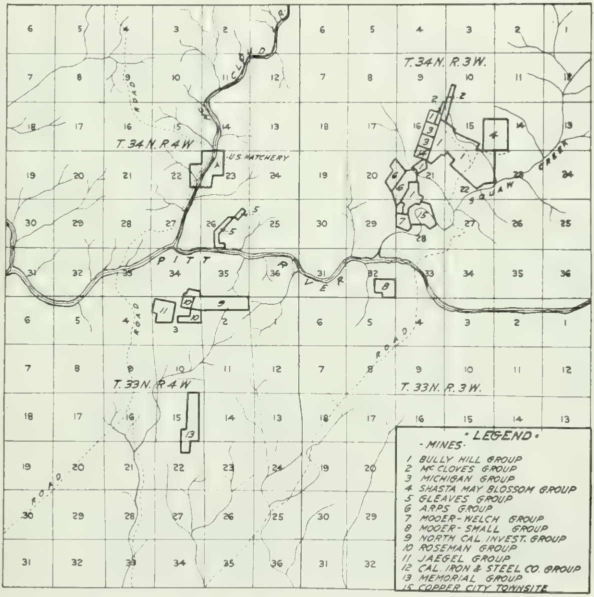
Ore-bearing Fissures. The fissures which gave access to mineral-bearing solutions, and thus permitted the formation of deposits of copper and auriferous quartz, originated chiefly during the epoch of rock crushing and mountain making about the close of the Jurassic. This is indicated by the fact that the fissures bearing ore have been found in the Jurassic rocks, but not in the Cretaceous. The important ore-bearing fissures of the copper districts are irregular in trend. The greatest extension of the copper region is in a direction about N. 80° E., while that of the several districts range from N. 50° W. to N. 30° E.

---

[1] This section on copper is a revision and reprint of an article published in our Report XX, pp. 419–447, 1924, with changes and additions needed to bring it to date.

[2] ACKNOWLEDGMENTS. The writer wishes to acknowledge the uniform courtesy extended him by owners and operators of mines throughout the Shasta Copper Belt.

PLATE I.



MAP OF A PORTION OF THE SHASTA COUNTY COPPER BELT EAST OF THE SACRAMENTO RIVER, INCLUDING THE BULLY HILL DISTRICT, SHOWING THE PRINCIPAL MINING PROPERTIES.

The general trend of the Iron Mountain district is N. 30° E., but the strike of its ore-bearing fissures rarely conforms to the general direction. The strike of the ore-bearing fissures about the head of Motion and Spring creeks varies, but the principal mineralized fissures usually have a course of N. 70° W., whereas on the north slope of Balaklala Mountain and beyond Squaw Creek their general course is nearly N. 70° E., though locally diverted.

The rocks in this region are much sheared, and in all parts of the district the fissures containing the ore deposits are usually those that show the greatest amount of shearing.

In the Bully Hill district the principal ore-bearing fissures have a course of about N. 10° E., parallel with the greatest extent of the producing district, although there are local variations of minor importance.

In the Ingot district the principal ore-bearing fissures have a general strike of N. 50°–60° W. The dip of the ore-bearing fissures throughout the copper belt is usually vertical or at a high angle, but there are a number of prominent variations, as at Shasta King and Mammoth mines, where the dip westward flattens and locally may be reversed.

Distribution of Ores. The principal orebodies of economic value have been found only in the Balaklala and Bully Hill rhyolites. These orebodies occur in irregular fissures along which there has been much shearing, and the orebody is as a rule irregularly lenticular in the shear zone. These lenticular orebodies range from a mere seam to a hundred feet in diameter. They succeed one another with the same irregularity in a more or less continuous shear zone, or occur in adjacent parallel shear zones. The maximum width of orebodies that have been worked is 300 feet, with a known length of 1000 feet.

Depths of Ore Deposits. The ore deposits have been developed throughout the district to a depth of 1500 feet below the surface.

Grade of Ore. The material mined in recent years does not average over 3 per cent copper.

Character of Ores and Gangue. The present ores of the copper region are almost exclusively sulphides, the metals contained being iron, copper, zinc, and small proportions of lead, arsenic, silver and gold. The minerals are pyrite, chalcopyrite, bornite, chalcocite, spalerite and galena. The upper portion of the orebodies consists largely of limonite.

Production.

The exploitation for copper in Shasta County began in 1895 at Iron Mountain, and the total production from 1895 to 1924, inclusive, is 646,964,136 pounds valued at $104,381,973. About 6,000,000 tons of ore has been produced from the county's mines.

History.

Copper was discovered and mined in Shasta County at Copper City in 1862. It was not until 1895 that operations were started at the Iron Mountain Mine by the Mountain Copper Company, and this marked the discovery and development of the immense sulphide orebodies of the copper belt of Shasta County.

The principal productive mines on the west end of the copper belt have been Balaklala, Golinsky, Iron Mountain, Mammoth, and Shasta

King. On the east end of the belt are the Bully Hill and Rising Star mines at Bully Hill, and the Afterthought Mine at Ingot.

The copper mines of Shasta County have been under active operation from 1895 to 1919, and Shasta County led all other counties in California in the output of copper during those years; but in 1920–1922 production was small, recovering somewhat in 1923 and 1924. The history of the principal districts in the copper belt is briefly described according to the importance of the mines.

Bully Hill and Copper City Districts.

In 1863 about 250 tons of ore were shipped to San Francisco. This ore is said to have contained 8 per cent copper, with values of $40 in gold and $20 in silver. From San Francisco the ore was shipped to Swansea, and gave a small margin of profit. The ground now covered by the Bully Hill Group of Mines was first located by Alexander Sanford. Jack Killinger and J. P. Williams formed a company and operated the Excelsior Mine, located near Copper City, until 1865. At the same time, the Baxter Mine was operated by the Baxter Mining Company.

At Bully Hill, O. R. Johnson & Co. acquired the claims located by Sanford, and began operations under the name of the Bully Hill Gold and Silver Copper Mining Company. In 1877, Alvin Potter & Company reopened the Bully Hill Mine. Then the property passed to the Extra Mining Company, which built the first mill in Copper City in 1877. This company operated the property for three or four years, when operations were suspended on account of their inability to treat the base ores. About 1897, James Sallee obtained the Bully Hill Mine, and after three years of development work sold the property in 1899 to J. R. De La Mar for $225,000. In 1901, the property was transferred to the Bully Hill Copper Mining and Smelting Company, of which J. R. De La Mar was president.

This company opened up the Bully Hill Mine, erected smelting works which then included a blast furnace with a daily capacity of about 150 tons, a converter plant of 150 tons, a battery of 60 roasting stalls, and two McDougall roasters. The first ores treated by this plant are reported to have carried as high as 15 per cent copper. During the operation of the plant by this company, the average ore treated is stated to have been around 5 per cent copper.

In 1905 the property was sold by the De La Mar interests to the General Electric Company. The General Electric Company opened up the Rising Star Mine, besides doing additional development work on the Bully Hill Mine. The smelting works were enlarged and smelting operations resumed.

The Sacramento Valley and Eastern Railway was completed from Pit, a station on the Southern Pacific, to Bully Hill. The smelter was operated by the General Electric Company until 1910, after which only development work was done. The company built a small experimental plant to try out electric smelting and recovery of the zinc values. This plant was operated in 1915, producing 300 to 400 lbs. of metallic zinc per day, using direct electrolysis of zinc sulphate with regeneration of acid.

In October, 1917, the W. Arnstein interests, known as Bully Hill Mining Company, took over the property; the Rising Star shaft was repaired, and silver-gold-copper ore extracted from the lower levels was shipped to the Mammoth smelter at Kennett. The production in 1918 amounted to 27,000 tons of selected ore, averaging 6 per cent copper and $1 in gold and silver per ton. The property was operated until 1920 by W. Arnstein, who built a 150-ton flotation plant, but this treatment was unsuccessful. In 1920 the property was sold to the Shasta Zinc and Copper Company, D. C. Jackling, president, and W. Arnstein, vice president.

The Shasta Zinc and Copper Company constructed a 150-ton reverberatory smelter and zinc oxide plant, and the plant was put in operation in June, 1922, and operated until December, 1922, when operations were suspended due to fall in the price of zinc oxide.

Iron Mountain District.

The Iron Mountain or Mountain Copper Mine was discovered in the early sixties, and located by William Magee and Charles Camden of San Francisco, as an iron mine. It was held as an iron deposit until 1879. In that year James Sallee and Alvin Potter acquired a one-third interest in the property, and operated the mine for its gold and silver values. In 1884, John O. Earl and Charles Ellsworth bonded the property, and placed a 20-stamp mill on it. Before any production was made, the entire plant and mine were returned to the original owners. James Sallee, as part owner and superintendent, operated the mine until 1888, when it was purchased by the Mountain Mines Syndicate, Ltd., of London, England. This company extended one of the prospect tunnels, encountered and developed a large body of copper-sulphide ore, and proceeded to operate the mine as a copper mine.

On January 1, 1897, the entire property of the Mountain Mines Syndicate was transferred for $5,750,000 to the present Mountain Copper Company, Ltd., of London. The Iron Mountain Mine was operated continuously until 1920, when operations were suspended.

The Mountain Copper Company also owns and operates the Hornet Mine, lying to the north of the Iron Mountain Mine. On this property 5,000,000 tons of pyrite ore have been developed, averaging 0.7 per cent copper, and carrying 47 to 50 per cent sulphur. This mine has been under continuous operation, daily production being from 400 to 500 tons of pyrite ore.

The company also owns and operates a 350-ton smelter at Martinez, California, and a 150-ton leaching plant. At this plant the Hornet ores, low in copper but rich in sulphur, are burned and the sulphur fumes are collected in lead-lined chambers and transformed into sulphuric acid by the Meyer chamber process; the cinder remaining after roasting is leached for its copper content. The acid is sold crude, and is also used as the basis of commercial fertilizers. The fertilizer plant was operated to full capacity in 1920, and a gas purifier, bluestone and pigments made. At one time this company was among the large copper producers of the world. Between 1901 and 1919, they produced over 122,000,000 lbs. of fine copper.

The Mammoth Mine, which is located in the Iron Mountain district, has been the largest producer of copper in the Shasta copper belt. This property, which originally consisted of twelve claims and a patented section, was owned by R. M. Saeltzer and associates of

Redding. In 1904 it was purchased by the Mammoth Copper Mining Company, a subsidiary of the U. S. Smelting, Refining, and Mining Company, Boston, Massachusetts. The smelter located at Kennett was built in 1905, and in 1908 the plant was enlarged to its prosent capacity. The mine and smelter were under continuous operation until May, 1919.

The Balaklala Mine was developed by the Balaklala Mining Company of San Francisco, in 1900. In 1902 the Western Exploration Company secured a bond on the property and carried on extensive development work until 1905, when it was acquired by the First National Copper Company and operated under the name of the Balaklala Consolidated Copper Company, New York City, from 1906 until May, 1919, when operations were suspended. The mine was taken over under lease by the Mammoth Copper Company in 1923, and reopened in November, 1923, the ore going to the Mammoth smelter. At present it is under lease to Mason Valley Mines Company.

Ingot District.

The history of the mines in the Cow Creek or Ingot district has been in many respects parallel to that of Iron Mountain and Bully Hill. The earliest attempts at operation were made for the extraction of gold and silver values from the oxidized surface ores. Later, effort was made to work the basic ores by a process of roasting and milling. C. M. Peck, in 1872, obtained for a nominal sum the property afterward known as the Peck Mine, and now included in the Afterthought Mine, and began its successful operation upon the oxidized surface ores. In 1875 he erected a small reverberatory furnace, and later on a small water-jacket furnace was erected. Due to the refractory character of the ores treated, attempts to smelt the ore in these furnaces were unsuccessful. In 1903 the Great Western Gold Company acquired the property and installed a 42- by 150-inch water-jacket blast furnace having a capacity of 250 tons which was operated successfully. The smelter was blown in in 1905. In 1909 the property was acquired by the Afterthought Copper Company. This company installed a 300-ton reverberatory furnace, which was blown in in July, 1919; also a 300-ton differential oil flotation plant. The property was operated continuously until February, 1920, when operations were suspended. In February, 1925, California Zinc Co. began mining.

MINES.

Afterthought Mine. The property is located in Secs. 10, 11, 25 and 5, T. 33 N., R. 2 W., near the town of Ingot, which is 24 miles northeast of Redding. Holdings of the company consist of 1650 acres, of which 1550 acres are patented.

Late in 1923 the property was sold under foreclosure to Forest P. Tralles, of St. Louis, assignee of the executors of the will of J. T. Milliken, who it is said had advanced the Afterthought Copper Company over a million dollars. In February, 1925, California Zinc Company began mining ore under lease and option. J. F. Dugan, general manager, Bully Hill.

The 300-ton selective flotation plant which had been previously installed by Afterthought Copper Company under the management of Milliken, proved to be a failure, as the zinc and copper sulphides could not be cleanly separated. California Zinc Company has abandoned the plant and reverberatory smelter, and are sending the ore from this mine to Bully Hill for concentration, over a new aerial tram 8½ miles long. The tram and the concentrating process now in use are described under Zinc in this volume. The vertical depth is 800 feet. A new shaft has been raised from the seventh to fourth level and the orebodies formerly developed are being mined. Besides the shaft and winze workings where levels are run 100 feet apart, there is a main working adit, No. 4, which runs N. 85° E. 600 feet, then as a drift 500 feet southeast on the Afterthought lode and 400 feet northwest on Copper Hill lode. Zinc is now the principal product of the mine.

Ore deposits: The copper-zinc ore deposits are limited to zones of disturbance in which the country rock is crushed and sheared. The Copper Hill lode consists of two short, nearly vertical orebodies, approximately 350 feet apart. They lie close to the contact in rhyolite that encloses fragments of slate. The shear zone contains massive irregular lenticular orebodies. The two vein systems or lodes are known as the Afterthought and Copper Hill lodes, which strike northwest and dip 70° to the northeast. Approximately 300,000 tons of ore are reported to be developed, carrying 5.5 ozs. silver, 0.03 oz. gold, 16% zinc and 3 copper. The ore is a complex copper-zinc ore finely disseminated, composed largely of sphalerite, pyrite, chalcopyrite, and local traces of bornite. The gangue which forms less than 5% of the ore is barite, with some quartz and a trace of calcite.

Bibl: Cal. State Min. Bur. R. XIV, pp. 760–761; R. XVIII, pp. 596–598; R. XX, pp. 425–426. Bull. 50, pp. 102–105. A. H. Heller, M. & S. P. Aug. 2, 1919.

Akers Group of Mines is located in Secs. 6 and 7, T. 33 N., R. 5 W., 5 miles west of Kennett, in the Backbone mining district. Elevation 1000 feet. J. W. Akers of Kennett, owner. Holdings comprise fourteen claims, totaling approximately 280 acres, located along Squaw Creek, between the Mammoth and Balaklala mines, and adjoining the Trinity Copper Company's property on the east. The development work on these claims is confined to five tunnels along an intrusion of quartz-augite-diorite, about 200 to 300 feet in width, with a general easterly trend, which occurs in the Balaklala rhyolite. The gossan croppings are prominent and can be followed for about 1000 feet. The ore occurs in small irregular lenticular orebodies, along irregular fissures, one of which trends north and south, with a dip of 60° east, the other having a N. 40° W. trend. The ore is chiefly pyrite with more or less chalcopyrite and occasional traces of bornite, and carries $2 per ton in gold and silver. The present work is confined to No. 3 tunnel, where a series of parallel north and south and a N. 40° W. fracture are being drifted on; and some small lenses of ore have been exposed along these fractures, varying in width from 2 inches to 2 feet, and from 10 to 15 feet in length. In this tunnel there is a drift 261 feet north on a north and south fracture, and one to the south 244 feet on a parallel fracture. In this south drift the main N. 40° W. fissure was cut. On the claims located on the south side of Squaw Creek are two tunnels which have lengths of 100 feet. In the lower tunnel, which is driven on a N. 40° W. fracture, a small lens of ore 40 feet in length and about 2 feet in width has been developed. Samples taken from this orebody are reported to carry from 2% to 6% copper. One man employed on development work.

Bibl: Cal. State Min. Bur. R. XX, p. 426.

Arps Group of Mines is located in Secs. 20, 21, 28 and 29, T. 34 N., R. 3 W., 1¼ miles north of Copper City, in the Pittsburg mining district. It comprises fifteen patented claims, totaling 250 acres adjoining the Copper City claims of the Shasta Zinc and Copper Company. Owners are William Arps and R. M. Saeltzer of Redding. Elevation 900 to 1200 feet. The property is located on the Copper City lode, the shear zone in which the lode occurs traversing the Bully Hill rhyolite and having a general course of N. 30° W. The ore is pyrite, sphalerite and chalcopyrite, with barite as a gangue. Developments consist of six tunnels, two shafts and several crosscuts and winzes aggregating over 3000 feet. The most extensive workings are confined to the Globe, Hearst, and Kaiser Wilhelm claims. In these workings several small lenses of ore were developed, carrying values in copper, gold and silver. Several cars of ore have been shipped from the property to the Mammoth Smelter at Kennett, and are reported to have averaged $20 per ton in gold and silver, with low copper content. Equipment consists of blacksmith shop and tools, compressor house, Chicago pneumatic compressor, air drills, cars and track. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 761; XIX, pp. 89, 90; XX, p. 427. Bulletin No. 50, p. 110.

Balaklala Copper Mine consists of 72 patented claims, 1169 acres; also 800 acres of smelter and townsite land at Coram, in the Flat Creek mining district, in Secs. 10, 11, 12, 13, 14, 17, 20 and 21, T. 33 N., R. 6 W., about three miles northwest of Coram Station. Owned by First National Copper Company; office, 111 Broadway, New York. Officers, Thomas W. Lawson, president; W. A. Kerr, secretary, until May, 1919, when all operations were suspended. Under lease to the Mason Valley Mines Co., Thompson, Nev. The mines are located on the south side of Squaw Creek, at an elevation of 2400 feet. The country rock is rhyolite, ore occurring in lenticular masses as replacement of country rock in flat bodies, with slight dip to north, the greatest extension being to the east and west, with a series of north and south step faults, causing displacement from a few feet to more than 100 feet. The main ore-bearing fissure strikes N. 70° E., with a northwesterly dip somewhat steeper than the slope on which it occurs. The lode is well marked in places by heavy gossan, and has been traced more or less continuously for over a half mile. The main orebodies are developed for lengths of 900 and 1100 feet. The ore is cupriferous pyrite, copper values being mainly in chalcopyrite, with a little chalcocite and covellite, all carrying gold and silver values and said to average about 2.7% copper, 0.9 oz. silver, 0.03 oz. gold, 21.4% silica, 31.5% iron, 4.3% lime, 3.4% alumina, 2.2% zinc and 35.2% sulphur.

Developments consist of 20 tunnels, of which the main haulage tunnel, known as the Wiel, is 6000 feet in length, and has a large glory hole.

Ore reserves are said to be about 3,000,000 tons of 2.7% copper ore with 0.95 oz. silver and 60¢ gold per ton.

Production June 30, 1918, to May 15, 1919, amounted to 82,271 tons of ore, the net recovered values being 2.7% copper and $1.54 gold and silver, or a total of $178,352, copper being sold at 19.59¢ per pound. For the year 1917–1918, the mine produced 82,876 tons of ore assaying 2.29% copper, $1.57 in gold and silver, which compares with the previous year's production of 76,559 tons, netting $174,656. Shipments were made to the Mammoth smelter at Kennett. The smelting plant which was located at Coram has been dismantled and the material sold to the Shasta Zinc and Copper Company at Winthrop.

Mine equipment consists of hoists, 5 air compressors, air drills, electric tramway, motors, cars and track, ore bunkers (capacity 1000 tons), and 16,500 feet of aerial tramway from the mine to Coram.

Buildings include an office, store, school, hospital, sawmill, and about 75 dwellings.

The Mammoth Copper Company resumed operations on the mine in November, 1923, but worked only a short time. In March, 1926, Mason Valley Mines Co. leased the mine and put 10 men at work.

Five to eight tons per month of copper precipitate, assaying 50% copper, is recovered from the mine water.

Bibl: Cal. State Min. Bur. R. XX, pp. 427–428.

Baxter-Winthrop Group, formerly known as Copper City Mine, owned by Shasta Zinc and Copper Company, comprises the Excelsior, Brown, Humboldt and Baxter claims, located in Secs. 21 and 28, T. 34 N., R. 3 W., 1 mile north of Copper City, in Pittsburgh mining district. Developments consist of 3000 feet of tunnels and 1000 feet of drifts. The lower tunnel, known as the Winthrop tunnel, was driven northeast 1000 feet, developing an orebody which was stoped to the surface. On the Baxter Claim, in Baxter Gulch, there is a shaft 150 feet deep, which is connected by drifts with the workings from the Winthrop tunnel. All workings caved. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 428. Bulletin No. 50, p. 107.

Black Diamond Group of Mines. This group, consisting of a half section of land and eighteen claims, is located in Secs. 2 and 3, T. 33 N., R. 4 W., in the Stillwater mining district. Formerly operated by Northern California Investment Company, George Bayha, vice president and agent, Redding, California.

The ore on these claims occurs on the contact of McCloud limestone and quartz-augite-diorite, and at a number of points small masses of ore have been found along this contact. The orebodies discovered are small and irregular. The ore consists of chalcopyrite, pyrrhotite and magnetite. A large amount of development work has been done on the property, consisting of a number of tunnels. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 428. Bulletin No. 50, p. 108.

Brushy Canyon consists of 160 acres in Sec. 34, T. 34 N., R. 3 W., about two miles south of Copper City, in Pittsburgh mining district. Owners, W. Collins et al. Development consists of one tunnel 300 feet long. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 429. Bulletin No. 50, p. 102.

Bully Hill and Rising Star Mines. These properties are situated one and one-half miles north of Copper City, in Secs. 15, 16, 21 and 28, T. 34 N., R. 3 W., in the Pittsburgh mining district. Owned by Shasta Zinc and Copper Company, 1800 Hobart Building, San Francisco; D. C. Jackling, president; W. Arnstein, vice president; M. W. Enrich, secretary; G. T. Jackson, general manager; Louis Monohan, mine superintendent. They are being operated under lease and option by California Zinc Company.

At Bully Hill, there are two lodes that have been extensively worked, the Eastern or Delamar lode in the Bully Hill Mine, and the Western or Anchor lode in the Rising Star Mine. The general course of the lodes is N. 10° E.; dip, approximately vertical. They are almost parallel and are about two hundred yards apart. The shear zones in the rhyolite are more or less distinct throughout, and contain irregularly lenticular overlapping orebodies. These orebodies vary in extent and size from lenticular or sheet-like nodules a few inches wide, up to bodies of ore 100 feet in length and 12 to 30 feet thick. The greatest extent of the orebodies appears to be in a nearly vertical direction, pitching steeply north. The ore is composed of pyrite, chalcopyrite, chalcocite, mornite, sphalerite, and galena in varying proportions. The ore mined in the Rising Star Mine is principally sphalerite and some pyrite and chalcopyrite. Quartz is scarce in the gangue, and barite is more common, particularly in ore that is rich in copper. The average content of ore mined from the Rising Star Mine is about 22% zinc, 2% copper, 2 ounces silver, and 60¢ in gold. Since 1917 all development work has been confined to the Rising Star Mine. A series of lenticular orebodies have been opened up on the 5th, 6th, 7th, 8th and 9th levels.

Developments: The Bully Hill Mine has been opened by a number of tunnels with extensive drifts, crosscuts and raises, comprising several thousand feet. There are nine levels 100 feet apart, eight raises from 50 to 560 feet in height, and an 1100-foot crosscut tunnel on the Bully Hill Claim, about 600 feet below the gossan outcrop. At 1100 feet from portal of the tunnel, where the vein was cut, a 3-compartment shaft was sunk to a depth of 950 feet. No. 3 or main tunnel level is connected by chutes and raises with the upper workings, of which some of the drifts run along the lode 800 to 1000 feet.

Rising Star Mine. The underground workings were unwatered in 1917, the shaft repaired, and a large amount of development was done from 1917 to 1922, opening up a series of lenticular orebodies on the 5th, 6th, 7th, 8th and 9th levels. It is reported that 300,000 tons of ore have been blocked out. During 1918 and 1919, silver-gold-copper ore was shipped from the lower levels to the Mammoth smelter at Kennett.

Developments: There is a 3-compartment shaft 800 feet deep. The main adit tunnel (No. 5 level) intersects the shaft 219 feet below the collar, with six levels below No. 5 level, 100 feet apart, with drifts on the 6th, 7th, 8th and 9th levels. Ore is trammed through No. 5 level to storage bins, then hauled in cars by horses one-half mile to bins at the smelter at Winthrop.

Mine equipment: Electric hoist, 10-drill Ingersoll-Rand compressor, driven by 60-h.p. motor, blacksmith shop, and timber-framing shop. Mine water is handled by two 5- by 9-inch Aldrich quinplex pumps, each driven by 100-h.p. motor; one pump on 9th level, the other on

11th level. Electric power is secured from the Pacific Gas and Electric Company.

Smelter: The 400-ton smelter, idle since 1910, has been dismantled and moved to Winthrop. Some parts of it were salvaged and used in the construction of the zinc oxide plant. During 1920 to 1922, a reverberatory and zinc oxide plant having a capacity of 150 tons per day was constructed on this property. The plant was put in operation during the early part of June, 1922, and operated until December, 1922, when the plant was closed down due to fall in price of zinc oxide.

In August, 1924, the California Zinc Company was organized to take over the Bully Hill mine and smelter from the Shasta Zinc and Copper Company. J. F. Dugan, general manager.

This company abandoned the process used by the last operators (described in our Report XX, pp. 430–432) and have lately been making a bulk concentrate, as described herein under Zinc. Copper is at present a by-product.

Bibl: Cal. State Min. Bur. R. XIII, p. 62; XIV, pp. 763–764; XX, pp. 429–432. Bulletin 50, pp. 106–107. U. S. Geol. Surv., Redding Folio.

Colma Copper Group of Mines is located in Secs. 6 and 31, T. 33 and 34 N., R. 5 W., 6 miles west of Kennett, in the Backbone mining district. It lies between the Uncle Sam and Mammoth holdings, at an elevation of 2400 feet. Owners are M. E. Dittmar of San Francisco and Louis Monahan of Winthrop, California. The property was in 1924 under bond to the American Zinc, Lead and Smelting Company, 1012 Pierce Building, St. Louis, Missouri. C. B. Nichols, superintendent.

This group of claims was being developed through No. 5 tunnel level of the Uncle Sam Mine, with the hope of picking up the direct extensions of the Mammoth Mine ore trends along the so-called 'California Fissure' or shear zone. The trend of the tabular ore deposition has been developed in the Mammoth Mine from the point of original exposure for a distance of approximately 5000 feet through the Mammoth property towards the Colma copper boundaries. The course of the No. 5 tunnel level of the Uncle Sam Mine is N. 40° E., and it intersects the Uncle Sam vein 1200 feet from the portal. About 350 feet beyond this vein, a vein of quartz 3 feet in width was cut, which is heavily mineralized with chalcopyrite and pyrite. The crosscut tunnel has been driven ahead 1800 feet beyond the Uncle Sam vein, and the company plans to continue driving the crosscut to intersect the Mammoth ore fissure. The formations cut by this tunnel were quartz-porphyry and rhyolite.

Equipment: A 10 x 12-inch Ingersoll-Rand compressor driven by a 50-h.p. motor, air drills, cars, blacksmith shop, and dwellings. Electric power is secured from the Pacific Gas and Electric Company. Eight men were employed in 1924.

Bibl: Cal. State Min. Bur. R. XX, p. 432.

Donkey Mine consists of two patented claims comprising 40 acres in Sec. 11, T. 33 N., R. 2 W., in the North Cow Creek mining district, about two miles northeast of Ingot, and in the Shasta Forest Reserve. Owner, Afterthought Copper Company. Idle.

Bibl: Cal. State Min. Bur. Bull. No. 50, pp. 105–106; R. XIV, p. 765; XX, p. 432.

Golinsky Group, formerly known as Little Backbone, is located in Sec. 28, T. 34 N., R. 5 W., about four miles from Kennett, in the Backbone mining district. Owner, Mrs. B. Golinsky of San Francisco, California.

Holdings consist of 300 acres, patented, adjoining the Mammoth Mine on the east. The orebody developed extended 150 feet N. 70° E., dipping southeast, and to a depth of not over 100 feet. This orebody is approximately parallel to the Mammoth orebody. Formation is Balaklala rhyolite.

Workings consist of several tunnels, one being 800 feet in length, 400 feet of drifts and one stope. Ore bins and dwellings on the property. Produced $70,000. Idle.

Bibl: Cal. State Min. Bur. Bull. No. 50, p. 100; R. XIV, p. 766; XX, p. 432.

Greenhorn Mine. Owners, Atascadero Mining Company, 1014 Hobart Building, San Francisco, California; E. G. Lewis, president; C. E. Gilman, secretary; Albert Hanford, consulting engineer. The property is located in French Gulch mining district, in Sec. 6, T. 32 N., R. 7 W., 22 miles northwest of Redding. Elevation 2000 feet. Holdings consist of 15 patented mining claims and 120 acres of patented land. Total area of 420 acres.

The country rock is quartz-porphyry. The ore occurs as lenticular orebodies in a shear zone in altered rhyolite which strikes N. 60° W., with dip of 40° W., and is mainly chalcopyrite or pyrrhotite with some suprite in the upper workings, as well as malachite and azurite. Principal ore mined is chalcopyrite associated with pyrrhotite and pyrite. Some beautiful specimens of native copper were discovered in the upper workings of the mine. Orebodies developed varied from thin seams to 10 feet in thickness. Management claims 250,000 tons of 3% ore blocked out.

Development consists of six tunnels totaling over 3000 feet, the greatest depth of workings below the outcrop being 480 feet.

Equipment: Ingersoll-Rand 10 x 12-inch compressor, air drills, cars, blacksmith shop, and bunk houses. Compressor was driven by electric motor. Electric power secured from the Pacific Gas and Electric Company. Idle.

Bibl: Cal. State Min. Bur. R. XVII, p. 518; XX, p. 433.

Keane Copper Mines. Owners, Harry J. Keane, 3028 West Street, Oakland, C. A. Peterson, George A. Greenwood, Miss Bertha Johnson et al. Comprises 42 claims in the old Pittsburg district, in Sec. 4, T. 36 N., R. 3 W., and Sec. 34, T. 37 N., R. 3 W., 12 miles by trail from Sims Station on east side of McCloud River. They were located in 1925. The elevation of claims is 1400 to 4800 feet.

Assessment work consisting of seven adits from 20 to 135 feet long, four small open cuts and 2½ miles of trail, are reported to have been done. Seven men were employed during the summer of 1925 and three are working now (April, 1926).

The claims were not visited, but according to Keane, narrow veins of high grade copper ores occur in 'mineralized lava.' Samples said to come from the claims show good grades of chalcocite, chalcopyrite and malachite, and a little native copper. A chalcocite seam now being followed is said to be eight inches wide, and a vein of chalcopyrite is nine inches wide at the outcrop.

Kosk Creek Mine consists of 12 claims in Sec. 23, T. 37 N., R. 1 W., on Kosk Creek, near the 'big bend' of Pit River, at 2000 feet elevation and several miles north of the copper belt. Owners, W. Murray et al. Idle.

Bibl: Cal. State Min. Bur. R. XIII, p. 63; XX, p. 433. Bull. No. 50, p. 108.

Little Nellie Mine is located southeast of the Iron Mountain and Hornet Mines of the Mountain Copper Company, eight miles northwest of Keswick. Holdings consist of the Alleghany and Bennington groups, 30 patented claims. Area 575 acres in Secs. 27 and 35, T. 33 N., R. 6 W., in the Flat Creek mining district. Elevation 2400 feet. Owners, Pittsburgh and Mount Shasta Gold Mining and Milling Company; J. J. Schneider, president; T. V. Scott, secretary and managing director. Offices, 516 Federal St., Pittsburgh, Pa.

The mine was opened and worked for gold in the early days; however, all the later development has been in prospecting for orebodies carrying copper. Three parallel quartz veins known as the Little Nellie, Yorktown and Yorktown No. 2, occur in quartz-diorite. These veins strike N. 60° E. and dip 70° N. Width is 2 to 4 feet. The principal development has been confined to the Little Nellie and Yorktown veins. Stated production is $160,000 in gold.

Developments: Upper tunnel driven on the Little Nellie vein a distance of 1125 feet; lower tunnel driven on the Yorktown vein a distance of 3888 feet, with crosscuts driven to the Little Nellie vein. The upper and lower workings are connected by a shaft which is located 1600 feet from the portal of the tunnel. From this point a crosscut has been driven north 2260 feet, at which point a vertical winze has been sunk 522 feet deep. This winze cut some small lenses of ore, showing chalcopyrite associated with pyrite. No extensive orebodies were encountered in crosscut or winze.

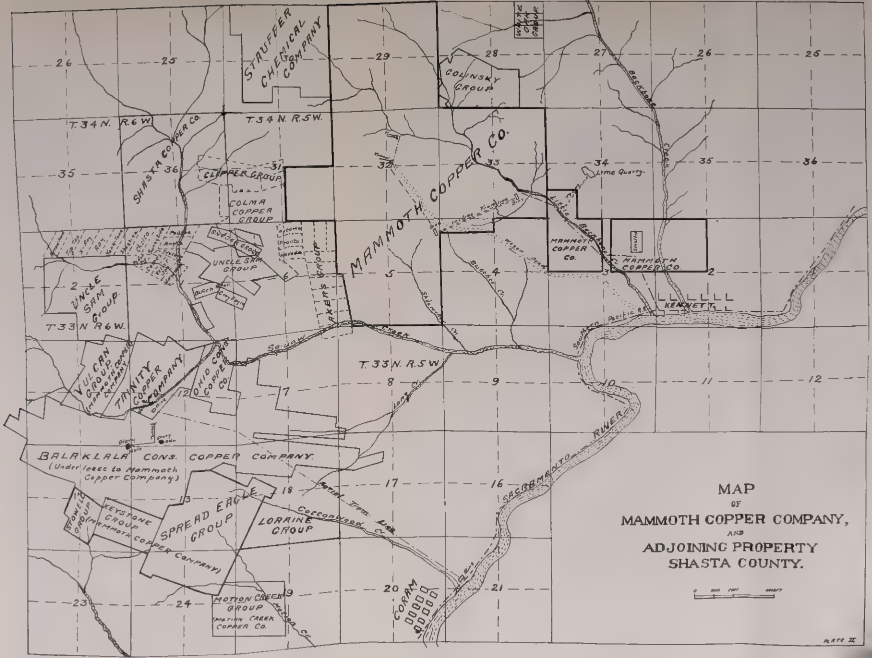
Equipment consists of 25-h.p. hoist (10 by 9 by 10-inch), Sullivan compressor driven by 50-h.p. motor, carpenter and blacksmith shops, and dwellings, and 15-stamp mill. Two men are employed.

Bibl: Cal. State Min. Bur. R. XX, p. 433.

Mammoth Copper Mining Company is a subsidiary of the U. S. Smelting, Refining and Mining Company, 55 Congress St., Boston, Mass. Mine office at Kennett, Shasta County, Cal. R. E. Hanley, superintendent. The Mammoth Copper Company was one of the largest producers of copper metal in California, and owns the most productive mines in the Shasta copper belt. The properties owned by the company are located in Secs. 2, 3, 29, 31, 32 and 33, T. 33 and 34 N., R. 5 W., about 4 miles northwest of Kennett. Elevation 3000 feet.

Properties: The Mammoth Group, which is the principal property, comprises 1117 acres, patented, and 434 acres, unpatented. The company also owns and operates the following properties (Plate II):

Anderson Group, consisting of 15 claims, 260 acres unpatented; Butters section, comprising 2719 acres; Crystal Group, 24 claims, 480 acres; Friday-Lowden Group, 150 acres patented, 188 acres unpatented; Keystone, 8 claims patented, 160 acres; Little Mammoth, 57 acres patented; Sheridan Group, 45.7 acres patented; Spread Eagle Group,



MAP
OF
MAMMOTH COPPER COMPANY,
AND
ADJOINING PROPERTY
SHASTA COUNTY.

PLATE II

22 claims, 163 acres patented; Stowell Group, 10 claims, 188 acres of which 128 acres are patented; Vulcan Group, 10 claims, 200 acres patented. The company also owns a 195-acre patented smelter site one-half mile north of Kennett; 184-acre patented town site, and 657 acres in additional tracts.

Mines.

Crystal Group. Consists of 23 unpatented claims and is located in Sec. 11, T. 33 N., R. 6 W., in the Flat Creek mining district, adjoining the Balaklala on the north, the Vulcan on the west, and about 3½ miles northwest of Coram. Owners, Mammoth Copper Company. Development by tunnels aggregates 200 feet. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 764.

Friday-Lowden Mine. Located one mile southwest of the Mammoth Mine. Development on the property has revealed one orebody 60 feet above the main crosscut tunnel, the strike of this body being N. 40° W., with a dip of 35° NE. The orebody extends up to the 670-foot level of the Mammoth workings. A winze has been sunk on this orebody from the 670-foot level to the Friday-Lowden tunnel level. The ore is chalcopyrite and pyrite, with quartz and barite as gangue.

Developments consist of a crosscut tunnel 4000 feet in length, with 1000 feet of crosscuts and drifts.

Keystone Mine. Located in Sec. 14, T. 33 N., R. 6 W., adjoining the Balaklala Mine on the south and the Stowell on the east. Elevation 3000 feet.

Development consists of two tunnels, the upper tunnel being driven S. 30° W., 300 feet, and the lower tunnel being driven S. 30° W., 2000 feet, with 2000 feet of drifts and crosscuts, the most extensive orebody being found 50 feet above the lower tunnel. The orebody is 100 feet in length, 50 feet thick, and strikes north with a dip to the east. It was developed during 1918. The ore is chalcopyrite associated with pyrite. It is stated that there are 20,000 tons of ore carrying 3% copper on the dump.

Equipment: 4-drill Laidlaw-Dunn compressor driven by 50-h.p. motor, air drills, ore cars, blacksmith shop, and dwellings.

Mammoth Mine. The Mammoth lode exposed in the Mammoth Mine has a course of N. 80° E., and has been followed for about 5000 feet. The principal orebody developed had a length of 800 feet and a depth of 200 feet from the upper gossan croppings. This orebody dips 30° NW. The orebodies consist of a series of long, flat-lying lenses, occurring irregularly in shear zones in the rhyolite. The ore is composed chiefly of pyrite, chalcopyrite, and sphalerite. Quartz is the gangue mineral, although much of the ore is a heavy sulphide only showing a trace of quartz. Ore as mined in recent years is said to average 3% copper with $2 in gold and silver.

Developments consist of 5 tunnels, No. 5, the main haulage tunnel, being 2500 feet long. It is known as the 500-foot level. The tunnel is 8 by 10 feet and contains a 3-foot gauge track, 56-lb. rail with electric haulage. No. 3 tunnel (300-foot level) is driven west 5000 feet to the shaft which from this level has a depth of 500 feet, with levels at 540, 670 and 780 feet. On the 540-foot level an orebody has been developed which strikes northeast. It is 30 feet thick by 250 feet in length.

Total of underground workings amount to 60,000 feet. It is stated that there are probably 25,000 tons of ore developed above the 500-foot level.

Spread Eagle Mine. Located in Sec. 13, T. 33 N., R. 6 W., and adjoins the Balaklala and Keystone mines on the east. The general trend of the ore fissures developed on this property is N. 70° W., and dip 75° SW. The ore is capped by a large mass of gossan on the steep slopes at the head of Motion Creek. The ore developed beneath the capping is pyrite with occasional small masses of chalcopyrite.

Development work consists of eight tunnels, aggregating about 3000 feet.

Stowell Mine. Located in Sec. 14, T. 33 N., R. 6 W., one-half mile west of the Spread Eagle Group, and adjoins the Keystone Mine on the west. Elevation 3100 feet. On the slope of the ridge north of Spring Creek, there is a large mass of gossan which has a general course of northeast. Crosscut tunnels driven into the ridge below the gossan croppings have exposed a massive body of pyrite ore. This orebody has apparently a course of N. 40°–60° W. The main tunnel is approximately 2000 feet in length. Other tunnels on the property aggregate about 800 feet. It is reported that ore reserves developed amount to 40,000 tons of 3% copper ore carrying $1.50 in gold and silver per ton.

View of Mammoth Mine, Mammoth Copper Company, Kennett, Shasta County.

Equipment: Aerial tram from the mine to the bunkers at the Balaklala Mine.

Sutro Mine. Located in Sec. 29, T. 34 N., R. 5 W., one mile north of the Mammoth Mine and adjoining the Summit Mine on the east. It is situated on the eastern slope of Bohematosh Mountain, at an elevation of 3000 feet. The tabular orebody developed occurs along a shear zone with a course of N. 70° E., and a dip to the southeast. The orebody is 25 to 50 feet thick and about 200 feet in length. The main working tunnel is driven north 2000 feet. No ore was found on this level, but the ore zone was encountered in an upraise from this level. On the northeast slope of the mountain there is a tunnel driven southwest about 1500 feet. at an elevation about 200 feet above the main tunnel. This tunnel intersected the orebody. There is another tunnel about 150 feet above this latter tunnel which was driven south 500 feet. developing some chalcopyrite associated with pyrite. Ore reserves are reported to be 40.000 tons, carrying 3% copper with $2 in gold and silver per ton. The workings are connected with the Mammoth Mine by a tram line 1½ miles in length.

Equipment: 20-h.p. electric hoist, Ingersoll-Rand compressor driven by 100-h.p. motor, blacksmith shop, and camp buildings.

Vulcan Mine. Located in Secs. 11 and 12, T. 33 N., R. 6 W., and adjoins the Shasta King Mine on the west. Holdings consist of 12 claims.

Developments consist of a crosscut tunnel driven north 1500 feet from the south fork of Squaw Creek. There are three other tunnels at a higher elevation. Some massive pyrite ore was developed in the upper tunnels but no ore was developed in the main crosscut tunnel. Idle.

View of the Sutro Mine, Mammoth Copper Company, Kennett, Shasta County.

Ore Transportation System.

The ore from the Keystone and Stowell mines was transported by aerial tram to bunkers at the Balaklala Mine, then by aerial tram to Coram, from which point it was hauled by train over the Southern Pacific tracks to the smelter at Kennett. Ore from the Sutro Mine was trammed by mules to bunkers at the Mammoth Mine. The ore from the Mammoth Mine was drawn from mine chutes on the 500-foot level, into narrow-gauge railroad cars, and taken over a 2-mile electric railroad equipped with two 25-ton electric locomotives, six 25-ton steel gondola cars, and nine 10-ton flat cars to ore bins with a capacity of 1000 tons. From these bins the ore was taken over an incline gravity railroad in skips to another set of bins. The gravity railroad has a length of 4000 feet and a drop in this distance of 1700 feet. The skips have a capacity of 20 tons of ore and travel at a speed of 2000 feet a minute. From these lower bins the ore was taken to the smelter over a steam railroad operated with three 40-ton locomotives and 22 standard steel railroad cars. The capacity of the transportation system is about 1500 tons of ore per day.

Smelter.

The smelter formerly in commission at Kennett was sold, complete, for junk in 1925 and was being wrecked at the time of visit, April, 1926. After having been shut down since May, 1919, the company had resumed operation in November, 1923, in anticipation of a continued improvement in the price of copper. These hopes were disappointed, and the last period of activity was short-lived, continuing only about a year.

This smelter had a capacity of 2200 tons and used the semi-pyritic process, using one car of coke to three of ore and silica. The excess iron in the ore was overcome by using an excess of silica and limestone, giving a thin slag. The copper matte was treated in five Allis-Chalmers converters and blister copper was shipped to the refinery at Chrome, New Jersey. Due to agitation against smelter fumes in late years, the smelter was equipped with a bag-house containing 2960 bags. There has accumulated from these bags an estimated total of 20,000 tons of flue-dust which contains copper, zinc, gold, silver, lead, antimony, cadmium and sulphur and is said to be worth over $20 a ton. No commercially successful method of recovering the values has been found.

Bibl: Cal. State Min. Bur. R. XIV, pp. 767–769; XX, pp. 435–438. Bull. 50, pp. 95, 97.

McClure or Pioneer Group of Mines. The property is situated in Secs. 9 and 16, T. 34 N., R. 3 W., 1½ miles north of Copper City, in the Pittsburgh mining district, and adjoins the Bully Hill Mine on the northeast. Holdings consist of the following claims: McClure, Andrews, Banner, Everett, Hope, and Poverty, totaling 160 acres; patented.

Development consists of a crosscut tunnel 500 feet in length. Owners, Mount Shasta Gold Mines Corporation.

Bibl: Cal. State Min. Bur. R. XIV, p. 769; XX, p. 438. Bull. No. 50, p. 110.

Minnie Haley Group of Mines is located on the west slope of Horse Mountain, in Sec. 24, T. 34 N., R. 4 W., 1½ miles northeast of Heroult. Elevation is 1800–2000 feet. Owners are James Doyle and George G. Dean of Redding. Holdings consist of 8 claims.

The ore is found along epidote dikes which occur in the Dekkas andesite on the western slope of Horse Mountain. The ore is chalcopyrite associated with iron pyrite in quartz gangue, and carries values in gold and silver.

Developments consist of four tunnels from 20 to 150 feet in length. Two men employed on development work.

Bibl: Cal. State Min. Bur. R. XIX, p. 92; XX, p. 439.

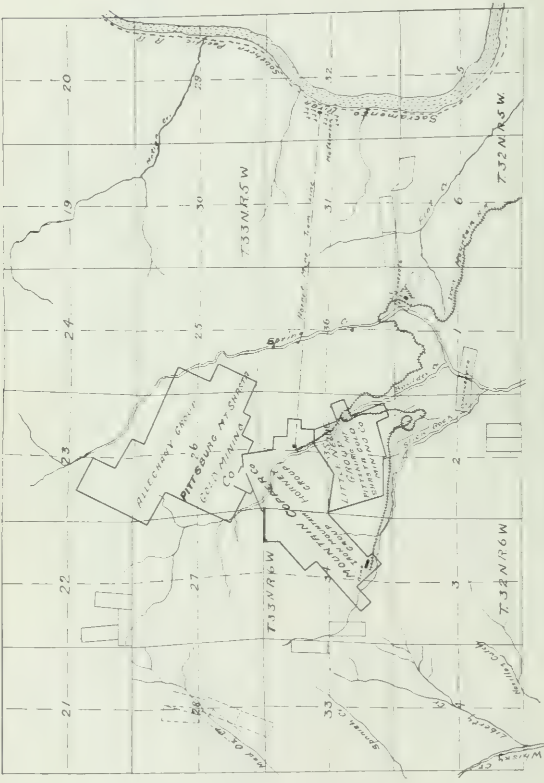
Mountain Copper Company's property includes the Iron Mountain and Hornet mines, comprising several hundred acres of patented land located in Secs. 34 and 35, T. 33 N., R. 6 W., 11 miles by railroad northwest of Keswick. Owners, Mountain Copper Company, 3 Lombard

St., London, England. Sir Charles Fielding, president; A. N. Frewer, secretary. Pacific coast office, 332 Pine St., San Francisco. W. F. Kett, general manager; M. F. Murphy, superintendent. Mine offices are at Mathewson, California.

Since the Fourteenth Report of the State Mineralogist, 1914, the Iron Mountain Mine operated until the early part of 1921, when operations were suspended, due principally to the low price of copper. In 1915, a 500-ton flotation plant was built at Minnesota Station on the Iron Mountain Railroad for the purpose of treating the low-grade ores from the Iron Mountain Mine. The Hornet Mine has been under continuous operation, producing from 400 to 500 tons of pyrite ore per day. A new crushing and sizing plant, with a capacity of 600 tons per day, was constructed and put in operation in October, 1920. In February, 1922, an aerial tramway from the Hornet Mine to Mathewson, a station on the Southern Pacific Railroad, was put in operation. It is 2½ miles in length and has a capacity of 100 tons per hour, and replaces the old Iron Mountain Railroad, used by the company for ore shipments for many years. The company ships 500 tons of pyrite ore daily to chemical plants near San Francisco. The Keswick smelter has been dismantled and the shops removed to Mathewson.

Hornet Mine. This mine lies to the north of the Iron Mountain Mine, on Boulder Creek, where a gossan capping, with a general strike of N. 30° E. is exposed, indicating the position of an immense orebody of pyrite which has been developed by a number of tunnels. One tunnel 300 feet above Boulder Creek is 500 feet in length on the eastern edge of the orebody. A lower tunnel, a short distance above the creek, follows the greater part of its length of 1600 feet along the western border. The main haulage tunnel is 10 by 10 feet, 3000 feet in length and is 180 feet below the old adit.

The ore occurs in a large fissure along a shear zone in the rhyolite. The lens of ore developed is several hundred feet in length; width and depth are undetermined. The general strike of the orebody is N. 30° E., with a dip almost vertical. The ore is nearly pure iron pyrite with not over 1% to 2% silica, the average copper content being 0.7% and the sulphur content 45% to 48%. The ore is mined by combination of shrinkage and caving method. Estimated tonnage of ore developed is about 5,000,000 tons. Ore is hauled from the mine by electric motor in trains of ten 7-ton cars to a bin at the crushing plant which has a capacity of 700 tons. From the bin the ore passes through a No. 6 Gates gyratory breaker, and is conveyed to a 4-foot trommel over the railroad bins, where it is screened into three sizes, namely: minus ⅜-inch; plus ⅜-inch; minus 1½-inch; plus 1½-inch, which includes pieces up to 4-inch maximum. About 10% to 20% of ore coming from the mine, containing waste, is classed as second-class ore and is dumped into separate bins. This ore is fed to a 4 by 12-foot trommel having screens with 1½-inch openings. The oversize from the trommel goes to the picking belt conveyor, where the waste is sorted out. This waste is conveyed to the waste dump, while the clean ore goes to a No. 6 Gates gyratory crusher. The undersize from this trommel goes to the jig storage bin. From these bins the ore is fed by means of a Challenge disc-feeder to four one-compartment Harz jigs. The concentrates from these jigs flow to a special dewatering bin at the railroad. The 1½- to 4-inch size material is shipped to the Standard Oil Company, at San Francisco, and the



MOUNTAIN COPPER COMPANY AND ADJOINING PROPEPTY

SHASTA COUNTY.

PLATE III

mine's $\frac{3}{8}$-inch material to the General Chemical Company, at San Francisco. The Standard Oil Company returns the pyrite cinder to the company's smelter at Martinez, where it is leached and the copper extracted. The Hornet Mine is the only property owned by the company that is under production. However, it is the company's plan to resume operations at Iron Mountain Mine when the price of copper will warrant reopening it. Two hundred men are employed.

Iron Mountain Mine. This mine has been operated since 1880, it being the pioneer copper mine of the Shasta copper belt. The company controls a large acreage on Iron Mountain, between Slick Rock and Boulder creeks. Elevation varies from 2400 to 3200 feet. The Iron Mountain fissure occurs in the rhyolite and has a course of N. 70° E., and dips 75° W.

Crushing and Sizing Plant, Hornet Mine, Mountain Copper Company, Keswick, Shasta County.

The ore deposits of Iron Mountain consist of immense masses of sulphides, mainly underlying a gossan capping 300 feet in width, but in places the ore occurs in and under rhyolite. The principal ore mass developed lies on the southern slope of Iron Mountain above Slick Rock Creek. This orebody was 800 feet long, from 100 to 400 feet wide, and 600 feet in depth below the gossan outcrop. It contained about 2,000,000 tons of ore of all grades. The ores are chalcopyrite associated with massive pyrite carrying from 2.5% to 5% copper, with $2 in gold and silver per ton. The pyrite orebody has been worked out, but it is reported the present ore reserves amount to 300,000 tons of siliceous copper ore carrying 3% copper. (Plate III.)

Developments consist of thousands of feet of tunnels, the principal tunnels through which the ore was mined being No. 8 mine tunnel, driven N. 10° W. 3000 feet, and at a higher elevation, the Confidence tunnel, driven N. 40° W. several thousand feet. The Complex Mine, which is located east of Confidence tunnel at an elevation of 3150 feet, has been driven north 3000 feet, intersecting the Iron Mountain fissure. An incline tram connects this mine with bunkers on the Iron Mountain Railroad, a distance of 1500 feet.

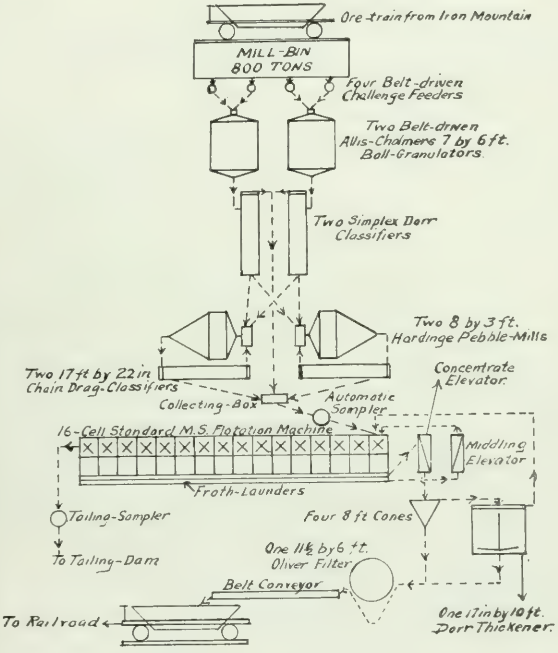
From 1915 to 1921, the principal production from the mine has been siliceous ore running 2%, which was treated in a 500-ton flotation plant.

Flotation Plant.

The crushing plant is at Iron Mountain Mine. The ore is delivered by electric haulage from No. 8 tunnel to the mine storage bin, which has a capacity of 1200 tons. The bin is covered with 30-lb. rails, spaced 10 inches apart. Oversized pieces are broken by sledge hammer. Ore from the bin is fed on a conveyor by six feed-gates, then to a 48-inch trommel, where it is screened to pass a 2½-inch ring, the oversize going to a No. 6 Gates gyratory crusher, and through-size being conveyed to the railroad storage bin which has a capacity of 700 tons. Through-size from the gyratory crusher goes to a 42-inch trommel, the oversize going to a picking belt, where high-grade chalcopyrite is sorted out for shipment direct to the company's smelter at Martinez. Through-size is elevated to a distributing conveyor, which carries the ore to the railroad storage bin. The capacity of the crushing plant is 600 tons in eight hours. A 100-h.p. motor drives the plant. The ore is hauled five miles over the Iron Mountain Railroad to the concentrator at Minnesota Station. The narrow-gauge ore train consists of a Shay engine and seven cars. The ore from the bin is fed by four belt-driven Challenge ore feeders to two belt driven Allis-Chalmers 7- by 6-foot ball granulators, then to two simplex Dorr classifiers. From the Dorr classifiers, oversize goes to two 3- by 8-foot Hardinge mills, in closed circuit with two 17-foot by 22-inch chain drag classifiers. Slimes from the Dorr classifiers go to a collecting box joining slimes from chain drag classifiers. The ore is ground to pass a 60-mesh screen. From the collecting box, the material goes to a 16- by 24-inch standard Minerals Separation

View of the Iron Mountain Mine, Mountain Copper Company, Shasta County.

flotation machine. Froth from the flotation machine is elevated to four 8-foot cones. Overflow from the cones passes to one 17-inch by 10-foot Dorr thickener. The chief object in the use of cones is to collect the coarser part of the concentrates amounting to about 75% of the whole. The coarse concentrate goes to one 1½- by 6-foot Oliver filter. The colloidal part of the concentrate which is drawn from the Dorr thickener is filtered separately. The concentrate averages something over 10% moisture. The ore milled averages about 2% copper, with 8% iron. and the concentrate runs about 15% copper. The average recovery is 92%. Ratio of concentration is about 7:1. The production


Ore-train from Iron Mountain
MILL-BIN 800 TONS
Four Belt-driven Challenge Feeders
Two Belt-driven Allis-Chalmers 7 by 6 ft. Ball-Granulators
Two Simplex Dorr Classifiers
Two 8 by 3 ft. Hardinge Pebble-Mills
Two 17 ft by 22 in Chain Drag-Classifiers
Concentrate Elevator
Collecting-Box
Automatic Sampler
16-Cell Standard M.S. Flotation Machine
Middling Elevator
Froth-Launders
Tailing-Sampler
To Tailing-Dam
Four 8 ft Cones
One 11½ by 6 ft. Oliver Filter
Belt Conveyor
To Railroad
One 17 in by 10 ft. Dorr Thickener.

FLOW SHEET OF 500-TON MILL
MOUNTAIN COPPER COMPANY.

PLATE V

from 500 tons of ore milled is about 70 tons of concentrate. Rated horsepower of plant is 590. (See Flow Sheet, Plate V.) Plant idle in 1926.

Bibl: Cal. State Min. Bur. R. XIV, pp. 769–770; XX, pp. 440–445. Bull. No. 50, pp. 70–78.

Mountain Monarch consists of 120 acres in Secs. 28 and 33, T. 32 N., R. 6 W., two miles south of Stella, in the Shasta mining district. Owners, Mountain Monarch Mining Company, of Redding. The ore, principally malachite, occurs in meta-andesite, and is five feet wide on the surface. A crosscut tunnel has been driven 700 feet, exposing some ore, but the main orebody has not been reached. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 770; XX, p. 445.

Ohio consists of 120 acres, patented, in Sec. 12, T. 33 N., R. 6 W., five miles west of Coram, in the Flat Creek mining district. Owners, Bliss Estate of New York. Several tunnels have developed some pyrite ore. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 770; XX, p. 445.

Shasta Belmont Mine consists of 7 claims located in Sec. 24, T. 34 N., R. 4 W., on Horse Mountain, west of the Bully Hill district, and 1½ miles northeast of Heroult. Elevation 1850 feet. Owner, Shasta-Belmont Mining Company; W. E. Carson, president; J. T. Davis, secretary. Offices, Carson City, Nevada.

Developments consist of two tunnels driven east along an east-striking fracture. The lower tunnel is 350 feet in length. Fifty feet above this tunnel there is another tunnel 225 feet long. Lower and upper tunnels are connected with a raise, also with a shaft 75 feet deep from the surface. The orebody occurs along an east fracture in Dekkas andesite, and where developed was from six inches to two feet wide, showing streaks and bunches of high-grade copper ore, mainly chalcopyrite and chalcocite, with pyrite in a quartz gangue. It is stated that three cars of ore which had an average value of 7% copper and about 4 ozs. silver, were shipped to the Mammoth smelter at Kennett. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 445.

Shasta King Mine consists of 16 patented claims known as the Shasta King Group, located in Secs. 11 and 12, T. 33 N., R. 6 W., 7 miles west of Kennett, on the south fork of Squaw Creek, and adjoining the Balaklala Mine on the north. Elevation 1650 feet. Owner, Trinity Copper Corporation; T. W. Lawson, president; John N. Reynolds, secretary; Allan Arnold, treasurer. Offices, 85 Devonshire St., Boston, Mass. The company also owns the King Copper and Lost Desert groups, located between Spring and Motion creeks, in Secs. 23, 24, 25 and 26, T. 33 N., R. 6 W., their total holdings comprising 1200 acres of mineral land.

The Shasta King orebody lies on the west slope of south fork of Squaw Creek, nearly opposite the Balaklala orebody, but at a lower level. The Shasta King orebody is somewhat irregularly basin-shaped. It is several hundred feet in width, with the longer axis running nearly north and south. It is limited for the most part by fissures, along which there has been decided shearing. These fissures have a general northerly strike. The gossan croppings are very prominent and can be followed by several hundred feet. The ore is chalcopyrite associated with iron pyrite, averaging 2% copper and 1 oz. silver, with small gold values.

Developments consist of crosscut tunnels driven from the side of the mountain at different elevations, which connect with drifts on the orebody. The main haulage tunnel is 1145 feet in length; another tunnel, 175 feet vertically lower, is 1100 feet in length. The orebody developed in these workings is a lens of massive pyritic ore 200 feet wide and 1000 feet long, but it does not extend down to the lower tunnel level. The different levels were known as 830-, 850-, 860-, 870-, 900- and 1045-foot levels.

Total underground workings are over 15,000 feet in length. It is stated the ore reserves amount to 400,000 tons. The ore was hauled from the main haulage tunnel by electric motor to 500-ton capacity bins. A double track incline 900 feet long transports ore from the bins to the Balaklala aerial tram.

Equipment consists of Laidlaw-Dunn compressor driven by 200-h.p. motor, cars, track, blacksmith shop, ore bins, laboratory, warehouse, shops, hospital, and about 25 houses for employees.

All the holdings of Trinity Copper Co. were attached in August, 1923, by the Federal National Bank of Boston.

Bibl: Cal. State Min. Bur. R. XX, p. 445.

Shasta May Blossom Mine is located in Sec. 14, T. 34 N., R. 3 W., one mile north of Winthrop, in the Pittsburgh mining district, and comprises 26 unpatented claims known as the Keith Group. Elevation is 1250 feet. Owner, Shasta May Blossom Mining and Smelting Company; C. M. Bradley, president; E. Seaburg, secretary. Offices, 604 Mills Building, San Francisco.

The workings are located along the contact of Bully Hill rhyolite and black and gray shales, the latter being the footwall. The top of the mountain is capped with rhyolite, and on the east slope of the ridge are gossan croppings.

Development consists of two tunnels, the lower being 720 feet long. One hundred feet vertically from this tunnel is the upper tunnel 600 feet in length, with a raise to the surface. Only small lenses of ore were developed, the ore being principally iron pyrite with small amount of chalcopyrite.

Equipment consists of Rix compressor driven by a 50-h.p. motor, also blacksmith shop, compressor house, and bunkhouse. Idle.

Bibl: Cal. State Min. Bur. Bull. 50, p. 100; R. XIX, p. 91; XX, p. 446.

Shasta National Copper Company's property consists of 38 unpatented claims located in Secs. 18, 19 and 20, T. 34 N., R. 5 W., on the ridge southeast of Backbone Creek, six miles northwest of Kennett. Officers of the company are: W. H. McEwen, president; M. P. Fries, vice president; Horatio Allen, secretary. Offices, M. P. Fries & Company, 1635 Broadway, New York. The property adjoins the Mammoth Copper Company's holdings. Development consists of a number of tunnels. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 446.

Summit Group of Mines is located in Sec. 30, T. 34 N., R. 5 W., four miles northwest of Kennett, in the Backbone mining district.

The principal workings are on the eastern slope of Bohematosh Mountain, and the claims adjoin the Mammoth Company's holdings on the west. Elevation 3100 feet. Owner, *Stauffer Chemical Company* of San Francisco.

The country rock is rhyolite, which is heavily mineralized with pyrite and chalcopyrite.

Development consists of three tunnels, one 400 feet long, with a 350-foot raise.

A 4-drill Sullivan compressor, shop, ore bins, and dwellings constitute the surface equipment.

The ore was transported to the Mammoth Mine over the tram line from the Sutro Mine. Idle.

Bibl: Cal. State Min. Bur. Bull. 50, p. 97; R. XIV, p. 773; XX, p. 447.

The King Copper Group consists of 23 claims about 2½ miles south of the Shasta King. The general trend of the orebody developed on this property is N. 70° W., dip 80° SW. The mine has about 1000 feet of development work. Idle.

Bibl: Cal. State Min. Bur. Bull. 50, p. 84; R. XX, p. 447.

Woodrow Wilson Mine is located in Sec. 4, T. 33 N., R. 2 W., 1¾ miles southwest of Ingot, in the North Cow Creek mining district. Elevation 1800 feet. Owner, Triumvate Mining Company of Ingot; H. M. Swift, president; J. H. Jones, secretary. Holdings consist of six claims, approximately 120 acres, located on the east copper belt, and adjoining the Afterthought Copper Company's property on the west. Two systems of veins have been developed, known as the Homestead and Woodrow Wilson lodes. The former occurs in a shear zone in the rhyolite, which lies south of the contact of the rhyolite and shales of the Pit formation to the north. Two shafts have been sunk on this vein to depths of 35 feet, developing 6 to 8 feet of quartz in which occur irregular lenses of ore. The ore is of a different character from that developed in the other mines of this district, in that it carries high values in lead. The quartz is mineralized with galena, chalcopyrite, pyrite and sphalerite.

The Woodrow Wilson lode lies close to the contact of rhyolite with black and gray shales, and strikes northeast, with a dip of 50 degrees to the northwest. The ore is similar to that of the Afterthought Mine, being composed largely of pyrite, sphalerite, chalcopyrite and galena, with local traces of bornite.

Developments consist of three tunnels: No. 1 tunnel, 260 feet, and 70 feet below it No. 2 tunnel, 600 feet. No. 3 tunnel is 100 feet below No. 2, and is a crosscut tunnel driven S. 70° E., 200 feet in the slate hanging wall towards the contact.

Equipment consists of cars, track, air drills, blacksmith shop, and dwellings. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 447.

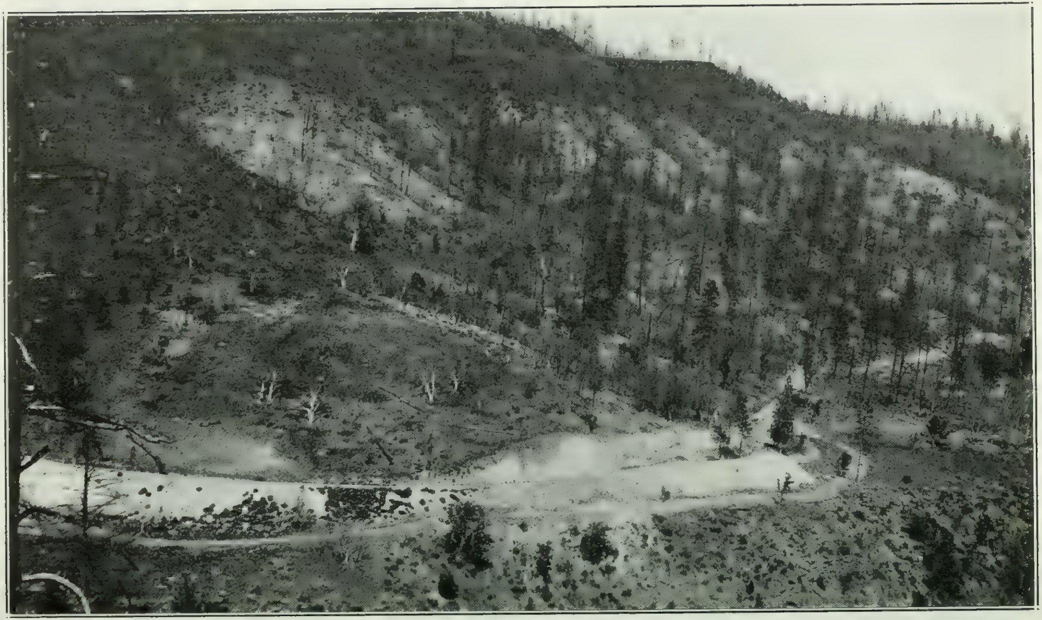
DIATOMACEOUS EARTH.

Among the largest deposits of diatomaceous earth in the state are those along Pit River from the region a few miles east of the mouth of Hat Creek on both streams, downstream to Pit 3 powerhouse. The material varies in quality as regards compactness and tint, in different localities, but there is an immense tonnage of good grade in sight. The region mentioned, in which mining claims have been located and are being held for this material, stretches for over 12 miles east and west, and four miles north and south. Not all of the land within this area is being held for mining, as parts of it had been previously alienated for farming, timber land and power purposes, although some of this land is underlain at very shallow depth by the mineral deposits. The full extent of diatomaceous earth deposits in Shasta County has never been definitely determined, and there is probably a great deal more of it than has been realized, in the eastern and northeastern sections where there was so much volcanic activity. The deposits were formed where the relatively recent volcanic flows dammed the rivers and creeks, forming lakes in which the siliceous deposits accumulated from some of the plant growth. Later volcanic flows then covered and preserved the deposits. The modern streams have cut through the lava in places, exposing the diatomite. Certain conditions will preclude the probability of development of some such areas. Among these conditions are distance from present or prospective railroads, amount of overburden on the deposits, location at or below ground water level which would mean a saturated deposit and expensive operation. Goose Valley, the region of Fall River Mills and some of the more remote lakes which were formed by lava dams, contain such deposits. A deposit of high quality also occurs 29 miles east of Anderson, in the southeastern part of the county.

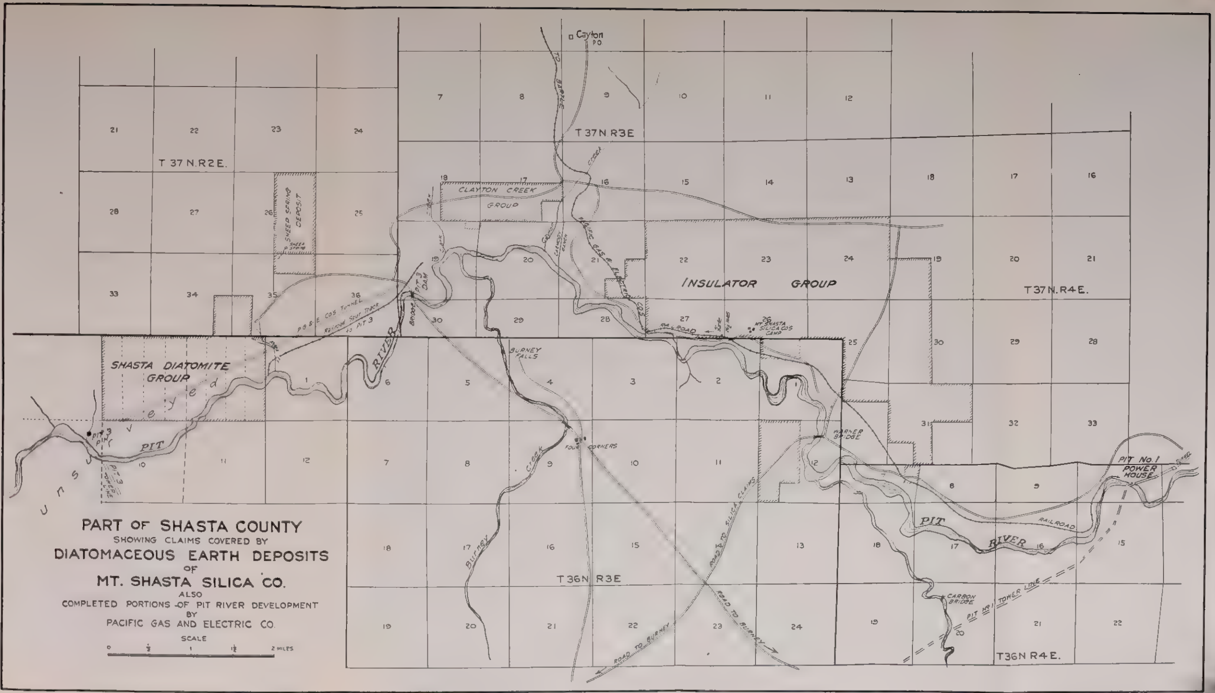
Mount Shasta Silica Company. Main office, 651 Howard Street, San Francisco. O. McCraney, president; M. H. Neimeyer, secretary and treasurer. Weed; C. O. Willis, superintendent. Holdings consist of 50 placer locations, over 7000 acres in all, along Pit River, but principally on the north side of the canyon from Sec. 33, T. 37 N., R. 2 E., to Sec. 10, T. 36 N., R. 4 E. Burney, the nearest town, is 13½ to 20 miles by good roads from the various claims. (See map, herewith.) The claims are on or near the line of Pacific Gas & Electric Company's broad-gauge railroad from Bartle to their power houses on Pit River.

C. O. Willis, one of the locators, had known of the deposits for 20 years but they were not located until 1921 and 1922. Since then considerable assessment work has been done running adits in the deposits and building roads.

The claims are in several groups. Insulator group lies north of Pit River and is a solid block of locations, 3½ miles wide east and west, and from 1½ to 3 miles long. The railroad runs along the north bank of the river, 25 feet or less in places above water level, along the entire frontage of this group. The deposits extend from the river level, 2752 feet elevation, to within a short distance of the top of ridge, where the diatomaceous earth is covered by lava. According to aneroid reading it is 340 feet vertically from the railroad track to the contact of over-



Diatomite deposit on part of Insulator group of claims, Mt. Shasta Silica Company. This photo, taken from the high bluff on south side of Pit River, shows a frontage of one-half mile and an equal depth from the river to the lava contact near summit. The contact is 340 feet vertically above railroad tracks in foreground.



PART OF SHASTA COUNTY
SHOWING CLAIMS COVERED BY
DIATOMACEOUS EARTH DEPOSITS
OF
MT. SHASTA SILICA CO.
ALSO
COMPLETED PORTIONS OF PIT RIVER DEVELOPMENT
BY
PACIFIC GAS AND ELECTRIC CO.

lying lava. Diatomaceous earth outcrops for this entire vertical range, and for about one-half mile north of the river, practically without overburden, the shallow soil cover not being enough to hide the white color. The photograph taken from the lava bluff south of the river, shows about one-half mile square of deposit.

Several of the railroad cuts have been made through the deposit, and show its character. It is partly pure white, and partly flecked by faint lines and splotches of yellowish iron oxide, but this stain is so faint that the amount of impurity is manifestly very small. The banks so far as exposed show a material of uniform and homogeneous character. Only occasional ''beach-lines'' or false bedding planes of sand occur and these are seldom over one inch in thickness. Taken as a whole, the various openings visited show a remarkably small amount of such visible impurities, which are confined to the narrow sand seams mentioned and to infrequent narrow seams called ''flint,'' which is perhaps partly opalized material. The deposits on this group show various degrees of density or consolidation, although as a whole probably a little denser than on other groups of claims. East of the camp, one detached deposit shows a bed sufficiently compact for sawing.

Several prospect adits and open cuts have been driven on these claims.

Since the deposition of the lava cap, erosion by the river and its small tributaries has dissected the deposit, leaving several detached bodies along the different ridges, so that a tremendous available tonnage, above water level, has been exposed by nature. The camp is about the center of this group, 13 miles by road from Burney. The material is ideally located for convenient and cheap mining and loading. At many places pits could be opened beside the tracks and the earth could be dumped directly into the cars using gravity entirely. All of these beds are within easy access of the railroad.

The diatomaceous earth continues northward under the lava cap, as shown at intervals along the road running north from Warner Bridge and that running west along the north line of the claims.

The Shasta Diatomite Group of claims covers all of two unsurveyed sections, which would be in sections 2 and 3, T. 36 N., R. 2 E., if surveyed, on the north side of the river eastward from Pit 3 powerhouse, and reaching an elevation of 2000 feet above the river. A branch of the railroad crosses the southeast corner of the group within a few hundred yards of an open pit site. Two short adits have been run here and show a very high quality of material, pure white, light and fine grained. A road was being built to these claims in April, 1926. These claims are well timbered and the outcrop is not conspicuous, differing in this respect from the Insulator Group, most of which has a sparse growth of scrub oak. This group of claims is being considered by the company for the initial productive operations, which they hope to begin during 1926.

The other deposits are called the Sheep Springs and Cayton Creek deposits. On the former occurs a very fine quality, soft and pure-white diatomite. An adit and several open pits have been opened here. On the latter, four short adits have been run. In all 32 adits have been run to prospect the different claims and several miles of road have been widened or built.

Equipment includes a tractor, auto trucks, and a small Gayco centrifugal air separator for preparing samples for shipment to prospective purchasers. There is a main camp building and several smaller ones.

The power company's railroad connects with the McCloud River Railroad at Bartle, 27 miles from the Mt. Shasta Silica Co.'s camp, and it is 36 miles from Bartle to Sisson, the junction with the Southern Pacific main line. One of the principal problems before the owners of the deposits is to secure railroad freight rates which will permit them to market their product to advantage. The size and quality of deposits justifies the belief that they are to be the basis of one of the county's most important future mining enterprises, and should so materialize within a few years if properly handled and encouraged. The available tonnage appears to be so great as to make any estimates superfluous and unnecessary. According to C. O. Willis, analyses of 105 samples have shown 84% to 90% silica, with only one as low as 78%; no clay nor lime and less than 1% magnesia. Temporary freight rates have been secured and the company hopes to begin carload shipments this year. Six men were employed when visited in April, 1926.

Analyses* of samples of diatomaceous earth from various claims of Mt. Shasta Silica Company.

Location	SiO_2	Fe_2O_3	Al_2O_3	CaO
Grade near Warners Bridge	81.39	2.18	8.32	2.27
R. R. cut near camp	82.09	1.65	8.09	1.15
Sec. 25, T. 2 N., R. 37 E. (Forestry Sta.)	91.33	0.92	2.59	0.66
Sec. 26, T. 2 N., R. 37 E.	90.58	0.65	1.43	0.27
Soldier Creek	90.28	1.26	2.52	0.15
No. 12, extreme west end	97.16	nil	trace	trace
Sheep Spring	96.02	0.62	1.03	0.12
No. A 107	88.05	1.08	6.25	1.00
No. A 52 R. R. cut next camp	90.25	0.65	1.55	0.25

* Analyses by Smith Emery & Co., San Francisco. Furnished by courtesy of O. McCraney.

Stewart and Moore Prospect. Owners, C. W. Stewart, Anderson and W. P. Moore, Redding. Contains 80 acres, unpatented, in S½ of SE¼ of Sec. 20, T. 31 N., R. 1 E., 29 miles by road east of Anderson and 23 miles from the nearest point on the Anderson and Bella Vista Railroad.

The prospect is on the west side of a ridge west of the south fork of Bear Creek, and at an elevation of 2700 feet. Two shallow prospect shafts close together show good quality, pure white diatomaceous earth with only one foot of soil overburden. Another shallow hole about 200 feet from the above also shows diatomite. The claims were located in 1925, and as the only work done so far has been one year's assessment work, a depth of only 12 feet has been reached. Nothing is known about the extent of the deposit either as regards area or depth, as the mineral does not outcrop anywhere else on the claims nor nearby and was discovered only because an old road had been cut through it. There are no other mining claims in the region, which is practically all patented and held as timber land. This section is covered by lava except where the streams have cut through. The deposit is of interest because it gives a hint of the possible occurrence of other similar deposits where the streams have been dammed up by lava flows in past ages, forming lakes in which diatomite has accumulated, only to be hidden by later lava and by soil, and not exposed to view until the streams cut new canyons.

GOLD (QUARTZ MINES).

This branch of mining in Shasta County has been quiet for several years past due in part to unfavorable conditions which have affected quartz mining generally, and in part to local conditions. The writer found little new development to record for the period between 1922 and 1926. The notes hereunder on quartz mining are therefore principally a compilation of past reports, which are included for the purpose of making the report as nearly complete as possible.

French Gulch district, adjoining Trinity County, and 20 to 25 miles west of Redding by good road, has been the most important quartz mining region in the county. Old Diggings district, two to three miles north of Keswick, has produced a great deal of ore, as have also the mines of Squaw Creek district, four to five miles west of Kennett. A number of mines have also been operated in the region beginning three miles west of Redding and extending through the Shasta and Whiskeytown districts. Only prospecting is going on in these sections now. The Dog Creek district, west of Delta, is practically deserted.

French Gulch District.

The geology of French Gulch district has been described by H. G. Ferguson in U. S. Geological Survey Bulletin 540, in which appears also a geologic sketch map, giving the areal distribution of the principal formations and the location of most of the mines. The district is the western part of the Weaverville quadrangle, for which the topographic survey was made years ago, but no folio has yet been published for the quadrangle. The mines of the Whiskeytown district are described in the same volume.

The quartz veins of French Gulch district occur principally in the carbonaceous slates of the Bragdon formation (Carboniferous) which rests upon the Copley meta-andesite. The veins lie usually in the vicinity of porphyry dikes.[1] The slate is generally crushed and sheared, but the dikes are not. Ferguson believed the vicinity of the contact became the locus of veins because it was favorable for fissuring, and that the ore deposits were genetically connected with the intrusion of the soda-granite porphyry. Quartz is the principal gangue mineral, with some calcite. Pyrite, galena, sphalerite and arsenopyrite are usually found, with galena and sphalerite predominating where slate is the wall rock. The gold is usually coarse. In many of the mines, the gold occurs concentrated into pockets or pocket shoots. A great many of these pockets have been mined by the professional pocket miners, who work usually in pairs or alone, with little outlay for equipment. Their workings are usually shallow shafts and narrow drifts, where they sink on the highest point of their gold ''trace,'' after having followed it patiently and skillfully perhaps for weeks. Among the numerous pocket mines, a few have been worked more extensively, the Five Pines Mine in Trinity County and the Mad Mule Mine north of Whiskeytown (Schilling) in Shasta County, being the best known. The pockets occur typically near the surface and at or near the contact of the black slate and meta-andesite or diorite porphyry. Manganese oxide has been regarded as a cause of the solution of the gold which geologists believe was precipitated when the gold-bearing solution came in contact with the carbon in the slate, causing the deposition of gold on the decomposed meta-andesite at or near the contact.

---

[1] Ferguson, H. G., Gold Lodes of Weaverville Quadrangle. U. S. Geol. Survey Bull. No. 540, pp. 22–79.

Quartz mining began in 1852 with the location of the Washington Mine. Gold production was greatest between 1900 and 1914. The largest producers with their estimated outputs were:

Gladstone	$3,000,000
Washington, nearly	2,000,000
Niagara	1,000,000
Milkmaid & Franklin	2,500,000
American	300,000
Summit	200,000

Old Diggings and adjacent districts.

There have been several productive quartz mines in Old Diggings district, of which the principal ones were the Reed, with a reported output of $2,500,000 and the Central, which produced about $500,000. The Reed Mine was active up to late in 1924. The mines here and at Quartz Hill have wide veins of solid white quartz. The country rock is a series of old igneous rocks, mapped as the Copley meta-andesite, or altered andesite. West of the railroad in Squaw Creek district, the country rock is the Balaklala rhyolite [1] in which occur so many of the important copper mines of the county. The Uncle Sam was the principal producer here.

While many of these mines have produced small and large bunches of rich ore, probably the greater part of their tonnage would be classed as low or medium grade smelting ores. Most of them were so conveniently situated that the ore could be delivered at low cost to the smelters formerly operated at Bully Hill, Keswick and Kennett. The quartz ore was in demand at the smelters for flux, and no doubt a great deal of it was utilized in this way that would have been too low grade to handle otherwise. Quartz of very low grade was worth two dollars a ton for flux, and could be mined and delivered over aerial tramways to the railroad cars at a cost which allowed some profit even if little or no credit were received for gold. The great variation in grade of ore is illustrated by the smelter returns from the Central Mine where the assay value over a period of several years for good-sized shipments, varied from $3.40 to $80 a ton, and averaged over $13 a ton for five years.

While some reduction plants were formerly operated at Old Diggings it is said that only about 50% of the gold was recoverable in the free state and smelting was the best method of treatment. Small amounts of pyrite and chalcopyrite occur. The Uncle Sam Mine, on the other hand, operated for many years with a 20-stamp mill, concentrators and a chlorination plant and is said to have produced over $1,000,000. In later years the mines depended entirely on the smelters to handle their ores, and as three smelters formerly active are dismantled, there is no activity in these districts now, although there remains unworked considerable ore of a grade similar to that already mined.

Whiskeytown and Shasta Districts.

In Whiskeytown district, which is west of French Gulch, only a little development work is going on, although at one time the district had several small gold quartz producers. Whiskeytown (Schilling P. O.)

---

[1] U. S. Geol. Survey Folio No. 138, Redding Folio.

is on the Trinity lateral of the state highway system, and the mines are 12 to 15 miles west of Redding.

The mines are mostly along the edge of a mass of alaskite porphyry and developments for the most part have been by shallow adits and shafts a few hundred feet deep. Numerous pocket mines have been worked. Milling ore is often lower grade and more complex than in French Gulch district, although a great deal of quartz in the eroded surface material and in numerous outcropping veins shows little sulphide. A striking feature is the great number of shallow workings to be seen. The large mass of alaskite-porphyry extends north from here, and the Iron Mountain, Balaklala and other copper mines are in it only a few miles away. Whiskeytown district has in late years been producing from a few hundred to $15,000 in gold per annum, depending on the success of the pocket hunters who make most of the production.

Many claims are being held, but little work is being done in Shasta district. The mines are in granodiorite, alaskite-porphyry and quartz diorite, east and southeast of the Whiskeytown district. The region was formerly famous for its placers, which have been worked out. The few pocket miners are the only producers at present. The Bonanza Gold Dollar Mine (now called Shasta View) made a little production several years ago with a 5-stamp mill, and promises to become active again. The principal producer was the Mt. Shasta Mine, adjacent to the Shasta View. The Mt. Shasta produced about $180,000 to a depth of 465 feet from ore said to have averaged $42.69 a ton. It has been idle for yeears and the plant has been burned down.

American Mine is in Secs. 12 and 13, T. 33 N., R. 7 W., on the ridge north of Cline Gulch, 3½ miles northeast of French Gulch at an elevation of 2800 feet. Owner, W. Frank, French Gulch.

It was located in 1887 and $2,000 was said to have been taken out with a hand mortar, after which tunnels were driven at different elevations between 2500 and 3150 feet and a 10-stamp water-power mill was erected. The estimated production was $300,000. The property contains 100 acres, of which 60 acres are patented.

The vein strikes N. 80° E. and dips 80° S. to vertically. Four adits, from 50 to 1400 feet long, were run. An ore shoot 125 feet long and 2 feet wide was stoped to a height of 240 feet. A depth of 650 feet was reached. Operations ceased about 1908. In 1923 a Nevada company did some work, but is not known to have made any production. In April, 1926, Art Brown, A. Fondahn and Nelson Wheeler took a lease and a bond on the mine and were moving a compressor to it preparatory to beginning work.

Bibl: Cal. State Min. Bur. R. VIII, pp. 564–565; X, p. 637; XII, p. 245; XIII, pp. 349, 357; XIV, p. 778; XIX, p. 135; XX, p. 15. U. S. G. S. Bull. 540, pp. 35, 60–61.

Bell Cow Mine, formerly known as *Arbuckle Mine*, is situated on the southwest slope of Arbuckle Mountain, in Secs. 35 and 36, T. 30 N., R. 9 W., 18 miles southwest of Ono. Owners: J. W. Carter, J. P. Erhart, Frank A. Greene, S. H. Fisk and Herbert Fisk of Redding.

Holdings consist of 16 claims, comprising 332 acres. On the property, there is a series of parallel siliceous dikes, the most prominent being west of No. 2 tunnel workings. The general trend of the main veins is northwest, and dip from 30 to 40 degrees westerly, toward a massive siliceous dike which is schistose in structure. This dike is 6 to 10 feet in width and extends over the full length of the Bell Cow No. 1 claim and into adjacent claims.

The different veins have been developed by 9 adits, at different elevations on the slope of the ridge south of the Middle Fork of Cottonwood Creek. At an elevation of 1800 feet, No. 1 tunnel is a crosscut driven 500 feet to cut vein opened up in No. 2 tunnel. About 50 feet above No. 1 is No. 2 tunnel, driven 203 feet on the main vein. In this tunnel a vein of quartz was developed from 2 to 4 feet in width. Reported to assay from $10 to $20 per ton. The shoot is 200 feet long. No. 3 tunnel is a crosscut tunnel, driven 165 feet to cut the same vein, and southeast of this tunnel is No. 4 tunnel, 75 feet in length to the vein. The other tunnels are caved, but reported to be from 20 to 150 feet in length. Total lineal feet of drifts and crosscuts is 1273 feet.

There is a 5-stamp mill on the property, 1050-pound stamps, 7″ by 9″ Dodge crusher, Challenge ore feeder, amalgamating plates, Woodbury concentrator, all driven by 15-h.p. Fairbanks Morse gas engine. Idle.

Bibl: Cal. State Min. Bur. R. XVIII, p. 493.

Central Mine. Owners, A. A. Anthony, 615 Pine Street, Redding, two-thirds; W. T. Thompson and J. W. Holbrook, one-third. There are five patented claims, containing 60 acres in all, in Sec. 4, T. 32 N., R. 5 W., in Old Diggings district, 11 miles by road north of Redding.

There are four veins on the property, three of which strike north and dip 65° east and the fourth strikes east. Work has been confined to the north-striking Central vein, which has been mined through adits. The lowest of these is the only one now accessible. It is a crosscut to the west for 956 feet, where it cut the vein and thence followed it north about 650 feet and also followed it southward until it pinched. This level gave about 335 feet of backs, and known ore above it has been stoped. One stope in the north drift was 150 feet long, 30 feet high and 10 to 15 feet wide. There was six feet of solid quartz on the footwall, the balance of vein being a stringer lead. The country rock is altered andesite. On the south, about 400 feet of work failed to develop ore. On this side, the vein pinched down to nothing.

This adit was run from about the center of Central Extension claim, through the Central claim to within 400 feet of the north end-line. About 300 feet west, on the Shasta claim, is the parallel Shasta vein, and the Pocket vein, also striking north, lies 250 to 300 feet east of the Central. The east-striking vein crosses the north end of claims, 300 to 400 feet north of the present face of Central adit, depending on dip of east-striking vein, which at the surface is about 45° north.

In the earlier work between 1885 and 1895 Huntington mills were used for crushing ore, the millsite being on the river some distance from the mine. It was found that only about 50% of the gold was recovered by this method. Later, shipments to Selby smelter, Keswick smelter and finally to Kennett were made. The total output is estimated at about $500,000, but smelter receipts for much of this have been lost. Receipts in Anthony's possession for shipments to the Keswick smelter between 1900 and 1906 show assay values ranging from $3.40 to $84 a ton, little of the ore going below $6 a ton, and the average for six years being over $13 a ton. Of course, much lower grade ore was shipped later, as it could be cheaply worked and delivered, and the quartz was worth $2 a ton as flux alone. A tramway delivered ore from the mine to railroad.

The lower part of this mine could be prospected to advantage from the Reid Mine shaft, which is nearby. There is no equipment at the Central.

Bibl: Cal. State Min. Bur. R. VIII, p. 565; X, p. 631; XII, p. 246; XIII, p. 351; XIV, p. 782; XVIII, p. 494.

El Dorado Mine. The property is situated one-fourth of a mile southwest of Tower House, in Sec. 3, T. 32 N., R. 7 W., in the French Gulch Mining District. Holdings consist of 40 acres of patented land. The mine is owned by James G. Conner of Redding; under lease to Messrs. Statton and Van Slyke of French Gulch. Discovered in 1885. Worked for seven years, 1912 to 1919. The workings are on the steep slope of a ridge north of Mill Creek at an elevation of 1500 feet. The lode lies along a fault contact of meta-andesite and black slate, striking N. 20° W. and dipping 35° east. Along the slate hanging wall, quartz occurs in lenses up to 2 feet in width. Occasionally the quartz is found in the meta-andesite close to the contact and usually mixed with fragments of andesite. Manganese stains are quite common in the quartz, which is oxidized.

Ore is mostly free milling, but some pyrite is associated with it. Numerous fine specimens showing free gold through the quartz have been taken out. Development work consists of a main adit tunnel, 450 feet long, driven northwest on the lode. At 250 feet from the portal of the tunnel, a winze has been sunk, on the vein 50 feet, with a drift north on the vein 26 feet. Here the vein varies from 2 to 3 feet in width. At the face of the drift the vein is cut off by a fault.

At 340 feet from the mouth of the tunnel there is an upraise 30 feet in ore. It is stoped out here for a length of 50 feet to top of raise, then the vein flattens and values disappear. It is reported that $4,000 was taken out of this raise. The gold occurs entirely in pockets in the quartz. Equipment: Blacksmith shop, tools, and bunkhouse and a two-stamp mill (850-lb. stamps) with triple discharge mortar and amalgamation plates, operated by 8-h.p. Fairbanks Morse Gas Engine. Two men employed.

Bibl: Cal. State Min. Bur. R. XII, p. 247; XIII, p. 355; XVIII, p. 406.

Ganim Mine is situated in Secs. 5, 8, and 15, T. 32 N., R. 6 W., 2½ miles northwest of Whiskeytown. Elevation is 1400 feet. Holdings consist of 14 claims, owned by the Ganim Mining Company, San Francisco. J. S. Ganim, president, Redding.

The country rock is meta-andesite with intrusions of alaskite porphyry. Two vein systems have been developed on the property, one showing pyrite ore, occurring in a shear zone, which strikes northwest and southeast and dips 25 degrees north. The country rock at a distance from the ore is a much sheared and epidotized meta-andesite in places slightly pyritized along joint planes. The lower workings on the property are not far from a contact of meta-andesite, quartz-diorite and dikes of alaskite porphyry which cut the meta-andesite in the vicinity of the tunnels. The ore where exposed near these workings is entirely pyrite. Besides the pyrite, the only other metallic minerals are rare specks of chalcopyrite, distributed irregularly throughout the ore. Other specimens of ore consist of meta-andesite in part replaced by pyrite. Developments consist of a number of crosscut tunnels which cut this shear zone at different places. These tunnels are from 50 to 400 feet in length. The ore developed has a width of 12 to 15 feet and is reported to carry values in silver. At higher elevation, a vein of quartz 4 feet in width has been developed. Strike of vein is N. 35° W., dip vertical.

At an elevation of 1800 feet, a crosscut tunnel has been driven N. 40° E., 120 feet to the vein, with a drift northwest 100 feet on the vein. The ore is white quartz carrying copper sulphides, bornite and chalcopyrite. Reported to carry $15 per ton in gold. This vein is developed by three other tunnels, and two shallow shafts.

A new lower adit is being driven at present to prospect at greater depth. About 425 feet from the portal in an easterly direction, drifts were turned and at time of visit attention had temporarily been diverted to a body of good grade talc which was encountered in both drifts. The talc strikes about N. 30° W. (See under Talc, herein.) Some galena has also been found lately.

Four men are employed, and several carloads of talc have been shipped. Equipment includes 9″ by 14″ compressor, air drills, drill sharpener, shop, 30-h.p. oil engine, 10-stamp Straub mill, one concentrator, mill building and small electric light plant.

Bibl: Cal. State Min. Bur. R. XVIII, pp. 730–731.

Gladstone Mine is in Secs. 1, 7, 8, 12 and 18, T. 33 N., Rs. 6 and 7 W., about 4½ miles northeast of French Gulch, containing 178 acres patented and formerly also 485 acres of unpatented claims.

It was discovered in 1896 and purchased by Hazel Gold Mining Company in 1901. They operated until 1915. The total production was over $3,000,000 and locally reported as high as $5,000,000.

The vein occurs in the slate, sandstone and conglomerate of the Bragdon formation, in a crushed zone 60 feet wide. It formed as branching stringers in the slate, or on the footwall side of the fissure, requiring the mining of considerable waste. The ore is white quartz, carrying less than one per cent of galena, zincblende, pyrite and arsenopyrite besides free gold, which carried 94% of the value. The vein strikes east, dips vertically for 1000 feet, changing to 60° south, then to north.

The upper part of mine to a depth of 1000 feet was worked through adits, from the lowest of which a shaft was sunk 1400 feet, with levels about 100 feet apart. Three separate ore shoots were worked in the upper levels; these united, and below the seventh level one was stoped. It is said that 1000 feet of drift was run to reach the shoot on 1300 level, but as the property was idle when the district was last visited, definite details were not obtained. The Ohio adit level was run 2000 feet.

In August, 1921, French Gulch Mining Company, of which Fred Searles of San Francisco was president and Wm. Simkins, secretary, took a lease on the property. The workings above the 300-level were unwatered and retimbered and a little rock was crushed, but work ceased in June, 1922, due to failure to develop new orebodies. The company produced about $20,000. In November, 1924, Harry Thompson of French Gulch began some work on the surface.

While under operation by Hazel Gold Mining Company the Gladstone was one of the two principal quartz gold producers of the county and was well equipped. Mine equipment included large double-drum hoist, compressor plant, electric power line nine miles long, electric locomotives for hauling ore, and shops. There was a 30-stamp mill (1050-lb stamps), with concentrators. The milling capacity was 100 tons a day and the average recovery must have been about $10 a ton during the later years of operation.

Bibl: Cal. State Min. Bur. R. VIII, pp. 568–569; X, p. 637; XI, p. 45; XII, pp. 248–249; XIII, p. 357; XIV, pp. 787–788; XVIII, pp. 43, 96, 256. U. S. Geol. Survey Bull. 540, pp. 57–60.

Gold Bar Mines. This property comprises four unpatented claims, known as: Gold Bar No. 1, Gold Bar No. 2, Gold Bar No. 3, and Gold Bar No. 4, located in Secs. 22 and 26, T. 33 N., R. 5 W., 10 miles north of Redding, in the Churn Creek Mining district. Elevation 1600 feet. Owners are Frank O. Hollingsworth and Dr. G. A. Grotefend of Redding. The mine has not been worked since 1891, when ore was mined and hauled to the National Mill, where it is reported to have milled $50 per ton. The property has been idle since that time, and was relocated in January, 1923. A vein of quartz four feet wide occurs in the meta-andesite, general course N. 30° W. and dip 55 degrees to the southwest. The outcrop of the vein can be traced for 6000 feet.

Developments consist of three tunnels driven on the course of the vein. The two lower tunnels are caved, but from the indications ore was stoped from the lower tunnel to the upper tunnel. The vein has been drifted on in the upper tunnel for 100 feet, developing an ore shoot 80 feet in length, and 4 feet in width. Samples taken from this vein are reported to assay from $10 to $15 per ton in gold. A raise from the intermediate tunnel connects with this tunnel, distance 30 feet. The present locators had two men employed cleaning out old workings in 1923, and were planning to drive a tunnel on the vein at a lower elevation. Idle in 1926.

Bibl: Cal. State Min. Bur. R. XIX, p. 93.

Harrison Gulch Mines. (*Midas*, *Victor* and *Twinvict* Groups.) Sold in part to State of California July 1, 1925, for five years taxes. Reported leased in 1926 to L. E. Lee, San Francisco. This consolidation includes the well known Midas Mine, the principal producer of the Harrison Gulch district, in Secs. 3, 4 and 10, T. 29 N., R. 10 W., in the southwestern corner of the county, 52 miles from Redding. The total acreage is about 2000 acres of mining ground, with which the last company also held 1400 acres of timber land, partly in Trinity County. The Midas Mine comprised 550 acres, and is the nucleus of the holdings, there having been little development on the other claims. The following notes are from previous published and unpublished reports, and the property was not visited by the writer.

The Midas Mine was discovered in 1894 by L. Benton and sold soon after to Midas Gold Mining Company, who operated it continuously from 1896 to April, 1914, when a fire occurred underground. During this period, the reported production was $3,563,587 from a total of

166,632 tons, or an average recovery of $21.38 per ton. Percentage of recovery was 76.83% and total operating cost was $9.15 a ton.

There are three veins, called Baldwin, Middle and Gold Hill veins, the first and last named being 400 feet apart and the Middle vein between them. They average 14 to 20 inches in width, strike north of west, and dip 50° to 75° southwest.

While the district has never been studied in detail nor mapped geologically, and the deeper mine workings have not been accessible for 12 years, the country rock of the immediate vicinity is reported to be diabase, covered in places by conglomerate. The veins are said to strike with the schistosity of the country rock, but dip at about right angles to the schistosity, and the wall rock has been so altered as to have the appearance of slate. This schistose zone varies in width. The quartz occurs in lenses which carry ore shoots of good grade, while elsewhere in the fissure there is little pay. The outcrop is in places only a seam.

The Baldwin vein was mined through a double-compartment shaft 1500 feet deep with 14 levels, over 26,000 feet of drifts and 11,000 feet of crosscuts and raises. Another shaft was sunk 600 feet on the Gold Hill vein and was connected with Baldwin shaft. A prominent fault striking N. 52° E. and dipping 60° southeast cut off both veins on the 1200 level. The old company is said to have followed the fault plane from the Baldwin to the Gold Hill vein, a distance of 435 feet, and 50 feet beyond, without picking up the faulted segments.

According to Roy Leach, mining engineer formerly employed at the mine, there is ore to the value of $150,000 blocked out in the lower levels, besides which there are ore possibilities on the Gold Hill vein in the Victor ground, and on the same vein beyond a fault. There are also two large veins which have been sampled only on top and found to be low grade, but have not been prospected at depth.

The equipment under the Midas Gold Mining Company included a 20-stamp mill, cyanide plant, 600-h.p. steam plant, steam hoists and complete surface plant, with some water power available during five months of the year.

After this company quit, the Victor Power and Mining Company took the property about 1915. They operated the cyanide plant on the stored tailings, until these were gone, milled some of the material on the waste dumps and some old fills from the upper levels. The old mill and cyanide plant were finally dismantled and two 30-ton Gibson mills were installed. They never succeeded in unwatering the mine below the 900 level, but ran the water level drift on the Baldwin vein an additional 1400 feet west in search of new ore-shoots. They quit about 1920. M. G. Henry plans a resumption of work soon, a few men having been taken to the property in March, 1926.

On the adjoining Victor property, now consolidated with the Midas, an inclined shaft 450 feet deep was sunk and three levels opened below the adit level. Only a little ore was milled in the 3-stamp Nissen mill. The vein was generally small and was lost west of the shaft. The veins in the Victor are supposed to be the same as in the Midas.

Bibl: Cal. State Min. Bur. R. XIV, pp. 792, 803.

Index Group of Mines. Located in Sec. 6, T. 32 N., R. 6 W., one-half mile north of Oak Bottom, in the Stella Mining District. Elevation

1500 feet. Owners, I. F. Rice and A. Kaleel of Whiskeytown. Holdings consist of 12 claims located on a ridge north of Clear Creek.

A series of parallel quartz veins occur in alaskite-porphyry intrusions in meta-andesite. The veins have a general east and west trend, with dips north. Widths vary from 2 inches to 6 feet. Developments consist of two tunnels, one 140 feet in length and the other 150 feet, and a number of shallow prospect holes and open cuts. There are three men employed on assessment work.

Bibl: Cal. State Min. Bur. R. XIX, p. 57.

Mad Mule Mine (one time called *Banghart*). It is five miles due north of Whiskeytown (Schilling P. O.), on Mad Mule Gulch, a branch of Whiskey Creek. This gulch was mined by placering in the early days, but more recently by numerous adits. M. T. Thomsen, 308 Laurel Street, Alameda, is owner. The mine has been worked by different pocket hunters in late years. The gulch is about one mile long.

The pockets in the mine have been found near a diorite porphyry dike which is as much as 150 feet wide and cuts the slate, alaskite porphyry and other rocks. The ore is mostly calcite in small lenses found on both walls, but said to be richer on the hangingwall. The lenses occur in troughs or along arches on the hangingwall or footwall respectively, and are said to be only a few inches thick, three or four feet long and sometimes 20 feet high.

This mine has been the largest producer of its class in the region. In the winter of 1922–23, a pocket was found which is believed to have produced between $7,000 and $8,000, one piece having yielded $4,138. This was taken out by two miners who had been permitted to prospect the mine and "keep whatever they could find." Two other men are said to have taken out about $2,500 the same season. Work was going on in 1926.

Bibl: Cal. State Min. Bur. R. IX, p. 38; XI, p. 396; XII, p. 252; XIII, p. 361; XIV, p. 791. U. S. Geol. Survey Bull. No. 540, pp. 40, 42, 52–54.

Milkmaid and Franklin Mines. They are situated on the north side of French Gulch, in Sec. 17, T. 33 N., R. 7 W., 3 miles northwest of the town of French Gulch. Owner, Western Exploration Co.

Holdings consist of eight claims known as: Franklin, Milkmaid, Summit, Ibex, Buckeye, Virginia, Peggy and May-Day; totaling 150 acres. The Franklin mine is reported to have been located in 1852, and the Milkmaid shortly afterwards. Total production of the two mines is reported to be $2,500,000 and from 1910 to 1922, the production was $496,000. Most of the development work is confined to the Franklin and Milkmaid claims.

Franklin workings: Two veins have been followed to some extent in the Franklin workings; one with a strike of N. 5°–30° W., and a steep dip to the east, the other with a strike of approximately E. and W. and a dip of about 70° N.

The wall rocks are slate and soda-granite porphyry. The veins are near the contact and cut both rocks, but tend to be best developed in the porphyry, fingering out in the slates.

The Franklin is developed by two adit levels, at elevations of 1950 and 2055 feet.

The Franklin or upper tunnel, driven N. 60° E., in porphyry, at 200 feet from the portal cuts the north and south vein, which dips 60° east. This vein above the tunnel level flattens to 45° and when within 30 feet of the surface, straightens up to 70°. Width of vein varies from 12 inches to 4 feet. The elevation of the Geiser tunnel is 1950 feet. It is a crosscut tunnel driven N. 60° E., following a fault fracture, and cuts the nort hand south vein at 450 feet from the portal. On this level the vein has been followed for a distance of 700 feet.

The Milkmaid workings: The Milkmaid joins the Franklin on the east. The rocks in the vicinity consist of soda-granite porphyry, diorite porphyry and slate. Both porphyries are intrusions in the slate. At an elevation of 1900 feet, the lower Milkmaid tunnel is a crosscut 220 feet to the vein, and is driven 50 feet beyond the vein, a total distance of 270 feet.

The vein strikes N. 10° W., and dips 80° east. On No. 1 level, the vein is drifted on, 150 feet north and 55 feet south.

The upper Milkmaid tunnel is a crosscut tunnel, 100 feet to the vein, with drifts 150 feet north on the vein and 25 feet south. On No. 2 level, the shaft level, drifts extend 300 feet south on the vein from the shaft and 100 feet north. About 200 feet north of the crosscut tunnel an incline shaft has been sunk to a depth of 200 feet. On No. 3 level there is a drift 150 feet south on the vein from shaft. No. 1 level is 50 feet below the upper tunnel level; No. 1 to No. 2 level is 100 feet, and No. 2 to No. 3 level is 70 feet. In these workings, the vein varies from a few inches up to 4 feet of quartz; above the upper workings on the Milkmaid and Franklin veins, extremely rich oxidized ore was taken out. The gangue minerals of the vein are quartz and calcite. Much of the quartz presents a faintly mottled grayish appearance due to enclosed wall rock. The sulphides in the ore are arsenopyrite, pyrite, galena and sphalerite. The sulphides amount to about 0.75 per cent of the weight of the ore, and carry $150 in gold to the ton. The ore in the main vein runs from $20 to $45 per ton and is in irregular pay shoots that probably pitch steeply to the south. The best ore is found where the vein is in the porphyry close to the slate contact.

Mine equipment: Consists of compressor plant, blacksmith shop, and bunk houses.

Reduction equipment: Consists of 10-stamp mill (1100-lb. stamps) and 4 Frue vanners, driven by electricity.

The property was under lease and bond during 1922 and 1923 to Captain H. E. Smith of Shasta, and work was carried on with a crew of ten men with Roy Leach as superintendent. The 10-stamp mill was operated on ore from the old dumps.

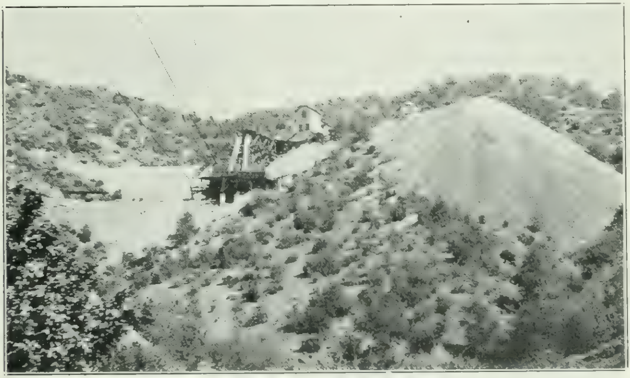
About January, 1925, E. E. Erick and associates began work and at present (April, 1926) the 10-stamp mill is in operation. The Milkmaid has been prospected, and plans for new work at the Franklin are reported.

Bibl: Cal. State Min. Bur. R. XIV, pp. 793, 794; Mining in Calif. Sept., 1922 (R. XVIII), pp. 406–409. U. S. Geol. Surv. Bull. 540, pp. 35, 61, 63, 64.

Reid Mine. It is situated eight miles north of Redding, in Sec. 3, T. 32 N., R. 5 W., in Old Diggings Mining District; elevation, 1700 feet. Holdings consist of 160 acres; a patented quarter-section.

There are several parallel auriferous quartz veins, striking almost due north, with steep dips to the east, in meta-andesite. The veins are large, varying from 6 to 30 feet in width, and very persistent. Gold values vary from $4 to $30 per ton. Development in recent years has been confined to the main vein. This has been opened on five levels, greatest length of pay chute was 400 feet; and maximum width 30 feet. Workings consist of 1100-foot vertical shaft, and main adit about 1000 feet long. This cut the shaft at the 300 foot level. Levels at 100 feet intervals below main adit. Ore shoot cut on 6th, 7th, 8th, and 9th levels. Stoped above the 8th level, but virgin ground below. On the 7th level, the vein was 16 feet wide, and on the 8th level, 30 feet wide, and said to have averaged $12 per ton in gold. Quartz is very pure, containing some tellurides, and sulphides of copper.

The property was operated continuously from 1904 to October, 1919, shipping all ore to the Mammoth Copper Company at Kennett, who used it for flux in smelting copper ores.



Reid Mine in Old Diggings District.

Equipment: Electric hoist, double drum for two compartment shaft; two 75-h.p. and one 50-h.p. motors driving 3 pairs of Ingersoll-Rand compressors, total capacity 1200 cu. ft. of air per minute; complete machine and blacksmith shop, cars and tools; and aerial tramway 4400 feet long to bunkers at railroad on west side of Sacramento River.

In 1922, the property resumed operation to furnish quartz to the Shasta Zinc & Copper Company's smelter at Bully Hill, which, however, operated only a short time. The mine was also active during the last operation of the Kennett smelter, which has been shut down about one year. Since the smelter shut down, the mine has remained idle, and at present, April, 1926, is slowly filling with water.

The Reid shaft has been suggested as the best place from which to start work to explore the Central, Evening Star and other nearby claims at depth. Several veins which have been productive in their upper levels could be prospected by crosscuts from the lower workings of the Reid, at points several hundred feet deeper than any previous workings upon these veins.

The property has been owned by the Reid Mining Company and was managed for years by Harvey Sallee. It was the principal producer of the district for many years, employing 80 to 100 men and producing 160 tons a day. Locally, the mine is reported to have produced about $2,500,000. In April, 1926, it was sold under trust deed to the McCormick Saeltzer Company and Redding National Bank of Redding and Capital National Bank of Sacramento.

Bibl: Cal. State Min. Bur. R. XIV, p. 797; XVIII, p. 408.

Sybel Mine. (*Accident.*) It is situated five miles northwest of French Gulch, in Sec. 7, T. 33 N., R. 7 W., in the French Gulch Mining District, on ridge between the North and South Forks of French Gulch.

Holdings consist of four patented claims which include millsite; total area is 80 acres. The property is owned by the Shasta Hills Mining Company, of San Francisco. Under lease and bond in 1922 to Harry Thompson and associates of San Francisco, who also controlled the Niagara group of mines, having under control 56 claims, and 520 acres of timber.

Operations were started on the Sybel mine in September, 1921, and the property was under continuous operation to May 1, 1923. It lies at the north edge of the complex of dikes which marks the position of the group of mines near the head of French Gulch. Soda-granite porphry similar to that of the Franklin, and diorite porphry, cut the slate. The ore for the most part lies in the diorite porphyry near contact of the slate, but in places the workings follow the contact itself, which here strikes about N. 80° W., and dips abou 50° north. The ore consists of blue-gray quartz with patches and streaks of white calcite. The quartz has a mottled gray color, but the calcite is milky white and cut by veinlets of quartz and arsenopyrite. The metallic minerals are pyrite, galena, sphalerite, and arsenopyrite. Gold, wherever in plates large enough to be visible, is as a rule close to the small patches of galena. The galena and sphalerite in the quartz indicates the occurrence of rich ore. The ore being stoped carries values from $10 to $200 per ton, and the average mill feed runs about $40 per ton.

Development: At an elevation of 3700 feet, a tunnel has been driven S. 75° E., 700 feet, and a winze has been sunk on the vein from this level to a depth of 150 feet; at 80 feet below adit tunnel, a drift has been run from the winze on the vein 175 feet east, and 175 feet west, developing a shoot of ore 350 feet in length. The vein varies from 12 inches to 4 feet in width. The adit tunnel is 400 feet below the outcrop of the vein. The adit tunnel cut a fault which strikes N. 50° W., and dips north 50°. The later workings on the tunnel level and in the winze are confined to the vein east of this fault, while old workings above this tunnel level were to the west of the fault. The vein strikes N. 80° W., and dips 50° north.

Mine equipment: Laidlaw - Dunn - Gordon 12″ x 12″ compressor, driven by 50-h.p. motor; air drills, blacksmith shop, and cars. There is a new 5-stamp mill on the property, 1000-pound stamps, and one vanner, driven by electric power, furnished by Pacific Gas and Electric Company.

The mine and mill were operated continuously during 1922, under the management of Harry Thompson, and the reported monthly production was $6,000 to $8,000 during part of the year. Operation ceased late in the spring of 1923, since when the mine has been idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 777; Mining in Calif., 1922 (R. XVIII), pp. 43, 138, 296, 408. U. S. Geol. Survey Bull. 540, pp. 68, 69.

Texas Consolidated Mine was one of the important producers of Old Diggings district for many years. Three veins were worked and according to past report showed little barren quartz. A 20-stamp mill was supported for several years on the ore from this mine. The main lower adit was run 1600 feet, N. 10° E., and is 910 feet below the outcrop following the main vein which dips 70° east and is said to have been 8 to 12 feet wide. It was faulted, and the last development work, which was done by Harvey Sallee in 1922 and 1923 consisted of two crosscuts, one to the east and one to the west, in search of the ore-shoot. The mine was idle in 1926.

Bibl: Cal. State Min. Bur. R. X, pp. 629–630; XI, pp. 395–397; XII, p. 258; XIII, p. 365; XIV, p. 800; XVIII, p. 206; XIX, p. 137.

Washington Mine. Owner, Washington Gold Mining Company. Original Washington claim and millsite contain 82 acres, patented, in Secs. 16, 17, T. 33 N., R. 7 W. Address C. C. Fox, French Gulch, and Dr. G. A. Grotefend, Redding.

This property covers most of the hill between the forks of French Gulch. It is the oldest quartz mine in the county and one of the very oldest in the state, as it was located in 1852. It became a producer soon after and continued in operation off and on for about 50 years. The total production is indefinite, but is variously claimed to have been from $1,000,000 to over $2,000,000.

The workings consist of a series of six adits from 300 to 2400 feet long, through which the mine has been developed from near the creek level at an elevation of 2000 feet, to 2900 feet elevation, near the top of ridge. The workings are partly in the slate, above 2400 feet elevation, and in meta-andesite below that. Two veins, one striking north and dipping 60° to 70° east, the other striking a little north of east and dipping north, have been worked. Small stringers and veinlets of quartz, occurring in proximity to many small dikes of soda granite porphyry, branch off and have yielded numerous gold pockets. According to H. G. Ferguson, the north-striking vein cuts off the other, which has been more extensively worked. The largest of the old stopes is said to be 400 feet long, 5 feet wide and 250 feet high. The vein pinches and swells. It is principally quartz with a small amount of galena, sphalerite, pyrite and arsenopyrite. The north-striking vein is in a well-defined fault and has lenses of quartz up to 10 feet wide.

The property was leased in 1922 to Thomas Salisbury and associates who employed 15 men and did some work as the Washington Development Company. Some ore was crushed during the year and 400 tons is said to have yielded $5 a ton free gold, but no important development resulted. At present, April, 1926, Fox and Grotefend have three men employed. They are driving ahead on ore in an adit 300 feet long. There is a 5-stamp mill on the property.

> Bibl: Cal. State Min. Bur. R. X, p. 635; XI, p. 50; XII, p. 260; XIII, p. 368; XIV, p. 804; XVIII, pp. 43 and 138. U. S. Geol. Surv. Bull. 540, pp. 64–66.

West End Mine. It is situated one mile southeast of Whiskeytown, in Sec. 16, T. 32 N., R. 6 W., in the Stella Mining District.

Property consists of West End Quartz mine and one-quarter section of patented land; total area is 180 acres. Owners: Dr. E. P. Mitchell of Winters, John Kesler of Anderson, and Western Star Lodge of Masons of Shasta. Under option to C. D. Jones & Company of Santa Barbara, California, in 1923.

Two quartz veins occur in the alaskite-porphyry; the West End vein strikes N. 50° W., dips 70° east; the Spanish vein strikes N. 27° E., and dips 80° west. These two veins evidently intersect about 90 feet south of the shaft. The veins vary in width from a few inches up to 2 feet. The ore is white quartz, showing free gold and some iron pyrite. On the 100-foot level, especially near the veins, the rock is much sheared. The alaskite-porphyry adjacent to the vein is in places partly silicified; and elsewhere near the veins is chloritized; in both situations a small amount of pyrite has been introduced. The zone of intense alteration of the porphyry is confined to the close proximity of the veins, and the silicified and chloritized porphyry carries no gold. In the siliceous phase, the alteration consists in the introduction of quartz along narrow and closely spaced fissures.

The development work has been confined to the West End and Spanish veins on the 50- and 100-foot levels, north of the shaft. Developments: Vertical shaft 100 feet deep. At 31 feet below the collar of the shaft, a drift was driven N. 19° E., and cut the West End vein, 110 feet from the portal, then continued 35 feet N. 16° E., and drifted on the vein N. 15° W., 180 feet, where the vein was cut off by a fault, which strikes N. 70° W., and dips 50° north. About 40 feet from where the vein was cut on this level, a crosscut was driven 100 feet N. 45° E., where it cut the Spanish vein, and this vein was drifted on 50 feet north and 55 feet south. On the 100-foot level, the West End vein was drifted on 200 feet north, to where the vein was cut off by the fault striking N. 70° W. A pump was installed by the last company and the mine unwatered. At 130 feet north of the shaft, a crosscut has been driven 80 feet N. 80° E., where the Spanish vein was cut, and a raise run on this vein in hopes of picking up the ore shoot developed in the Spanish stope, which has been stoped out for a distance of 60 feet along the vein from the drain tunnel level to the surface.

Equipment: 9-h.p. Hercules gasoline engine driving 6″ Mast-Foss rod pump; 30-h.p. boiler and steam hoist. Idle in 1926.

> Bibl: Cal. State Min. R. XII, p. 260; XIII, p. 368; XVIII, pp. 96, 256, 295–296, 409–410; XIX, p. 11.

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY.

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
Accident					See Sybel.
Advance Cons.	2	35 N.	6 W.	7 miles west of Delta	R. XIV, p. 777.
Alice (Alice Cons.)	19	32 N.	5 W.	1 mile SW. of Keswick	R. XII, p. 245; XIII, p. 349; XIV, p. 778; XVII, p. 519.
Alice				6 miles NW. of Ono	R. XII, p. 245; XIII, p. 349.
Alliance				5 miles W. of Redding	R. XIII, p. 349.
Alvina				4 miles N. of Horsetown	R. XIII, p. 349.
Al Toland	26	36 N.	6 W.	7½ miles W. of Delta	R. XIV, p. 778.
American	12, 13	33 N.	7 W.	3½ miles NE. of French Gulch	R. VIII, pp. 564-65; X, p. 637; XII, p. 245; XIII, pp. 349, 357; XIV, p. 778; XIX, p. 135; XX, p. 15. U.S.G.S. Bull. 540, pp. 35, 60-61.
Anavina					See Peerless Mine.
Annie				2 miles from Shasta	R. XIII, p. 349.
Arbuckle					See Bell Cow.
Atlantic	17, 20	31 N.	6 W.	3 miles NW. of Igo	R. XIV, p. 779.
Australia	19, 30	32 N.	6 W.	3 miles N. of Shasta	R. XIII, p. 362; XIV, p. 779.
Backbone				4 miles SW. from Kennett	R. XIII, p. 350.
Banghart					See Mad Mule.
Bell				7 miles W. from Ono	R. XII, p. 245.
Bell Cow	35, 36	30 N.	9 W.	18 miles SW. of Ono; 38 miles SW. of Redding	R. XVIII, pp. 296, 493-94.
Big Four				4 miles SW. of Shasta	R. XIII, p. 350.
Billy McCormick				13 miles NW. from Ono	R. XIII, p. 350.
Black Bear	9	22 N.	10 W.	1 mile S. of Harrison Gulch	R. XIII, pp. 350, 359; XIV, p. 779.
Black and Brown Bear				6½ miles W. of Kennett	R. XIII, p. 350.
Black Cloud and Red Cloud	15	32 N.	5 W.	4½ miles N. of Redding; 2½ miles from Keswick	R. XVII, p. 520.
Black Diamond Group	5	31 W.	18 W.	4 miles W. of Redding	R. XVIII, p. 296.
Blackfoot				4 miles S. of Shasta	R. XII, pp. 245-46; XIII, p. 350.
Black Hawk	14	31 N.	6 W.	1 mile NW. of Centerville	R. XIV, p. 779.
Black Prince					See Diamond Mine.
Black Spider	19	32 N.	5 W.	1½ miles SW. of Keswick	R. XII, p. 246; XIII, p. 350; XIV, p. 779.
Black Tom					See Niagara.
Bodie	6 32	32 N. 33 N.	7 W. 7 W.	3 miles SW. of French Gulch	R. XIV, pp. 779-80.
Bonanza	6	32 N.	6 W.	4 miles NW. of Stella	R. XII, p. 256, XIII, p. 364; XIV, p. 779; XIX, p. 11.
Bowery Bell				2½ miles NE. from Shasta	R. XIII, pp. 350-51.
Brackett					See Minneshasta.
Bright Star	31	32 N.	6 W.	4½ miles NW. of Stella	R. XII, p. 250; XIII, p. 359; XIV, p. 780. U.S.G.S. Bull 540, p. 55
Brunswick	20	33 N.	7 W.	5 miles W. of French Gulch	R. XIII, p. 351; XIV, p. 780; Bull. 540, pp. 35, 37, 68.
Bulwer and Virginia	18	33 N.	7 W.	5 miles NW. of French Gulch	R. XIV, p. 780.
Bullard and Vandever				12 miles NW. of Redding	R. XIII, pp. 351, 368; XII, pp. 259-60.
Bunker Hill	29	32 N.	5 W.	3 miles E. of Shasta	R. XIV, p. 781.
California and Oregon				3 miles SW. from Kennett	R. XIII, p. 351.
Calumet Consolidated	20	32 N.	5 W.	1 mile S. of Keswick	R. VIII, p. 563; X. pp. 631-32; XI, pp. 43, 395; XIV, p. 781.
Carnegie Group	1	33 N.	6 W.	7½ miles W. of Kennett	R. X, pp. 640-41; XI, p. 399; XII, p. 246; XIII, p. 351; XIV, p. 781.
Celestine					Now Double Header.
Central	33, 34	33 N.	5 W.	2½ miles E. of Copley	R. VIII, pp. 565-566; X, p. 631; XII, p. 246; XIII, p. 351; XIV. p. 782; XVIII, p. 494.
Chapman and Volutine	25	36 N.	6 W.	¾ mile S. of Centerville	R. XIV, p. 782.
Clara	17	32 N.	5 W.	½ mile W. of Keswick	R. XIV, p. 782.
Cleveland	15	32 N.	5 W.	4 miles W. of Redding	R. XIV p. 782.
Climax Mine	16, 21	31 N.	6 W.	3 miles NW. of Igo	R. XIV, p. 782.
Cllpper and Snider					See Carnegie Group.
Colorado	16, 17	33 N.	7 W.	3 miles NW. of French Gulch	R. XIV, p. 782.
Colorado				2 miles SW. from Shasta	R. XII, pp. 246, 256; XIII, p. 352.
Compton	20	33 N.	5 W.	1¼ miles S. of Keswick	R. XIV, p. 782.
Cons. Kascinaska	10	32 N.	5 W.	4 miles NW. of Redding	R. VIII, p. 570; XII, p. 254; XIII, p. 352; XIV, p. 783; XVIII, p 354.
Copley Mine	32	33 N.	5 W.	Near town of Copley	R. XIII, p. 352; XIV, p. 783.
Corrine	32	32 N.	5 W.	1 mile W. of Redding	R. XIV, p. 783.
Crown Point				6 miles W. from Delta station	R. XIII, p. 353

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY—Continued.

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
Daisy				5 miles N. of French Gulch	R. XIII, p. 353.
Deakin & Taylor					See Old Spanish.
Delta Cons.	1, 3, 6, 31	35 N. 36 N.	5 W. 5 W.	6½ miles W. of Delta	R. XIII, p. 353; XIV, p. 784.
Diamond Mine	18	31 N.	6 W.	4 miles NW. of Igo	R. XIII, pp. 355, 350; XIV, p. 784.
Doebleins				2 miles E. of Igo	R. XII, p. 247; XIII, p. 355
Dolcoath				2 miles E. of Shasta	R. XII, p. 247; XIII, p. 355.
Don Carlos					R. XI, p. 398.
Double Header	33	33 N.	7 W.	2 miles W. of Tower House	R. VIII, pp. 567-68; XVIII, pp. 138, 256, 354, 405; XIX, p. 11.
Dreadnaught				3 miles NW. from Shasta	R. XII, p. 247; XIII, p. 355.
Early Discovery				Near Shasta	Field Report, 1921.
Eastern Star				14 miles SW. of Redding	R. XII, p. 247; XIII, p. 355.
Edna B.	6	31 N.	5 W.	1½ miles E. of Shasta	R. XII, p. 247; XIII, p. 355; XIV, p. 785.
El Dorado	3	32 N.	7 W.	17 miles NW. of Redding; ¼ mile SW. of Tower House	R. XII, p. 247; XIII, pp. 355-56; XIV, p. 785; XVIII, pp. 405-406; XIX, p. 11. U.S.G.S. Bull. 540, pp. 56-57.
Emigrant					See Truscott.
Empire	9	30 N.	7 W.	3 miles SW. of Ono	R. XIII, p. 356; XIV, p. 785.
Empire	18	33 N.	7 W.	5 miles NW. of French Gulch	R. XIII, p. 356; XIV, p. 785.
Enright					See Old Spanish.
Esperanza	29	29 N.	10 W.	1½ miles E. of Harrison Gulch	R. XIV, p. 785.
Ethel				14 miles SW. of Redding	R. XII, p. 248.
Eureka Tellurium	32	32 N.	5 W.	3 miles SW. of Redding	R. VIII, p. 571; XI, p. 43; XII, p. 248; XIII, p. 356-57; XIV, p. 786.
Eureka					R. XVIII, p. 354.
Evening Star	4	32 N.	5 W.	2 miles SE. of Copley	R. XIV, p. 786; XVII, p. 520.
Florence	18	30 N.	7 W.	8 miles SW. of Ono	R. XIV, p. 786.
Florida Group	7, 12, 18	31 N.	5 W.	7 miles W. of Redding	R. XII, p. 248; XII, p. 357; XVII, p. 520; XVIII, p. 494.
Franklin	29	32 N.	5 W.	1½ miles SE. of Keswick	Field report.
French Gulch					See American Mine.
Gage and Martin				1½ miles S. of Shasta	R. XIII, p. 357.
Gambrinus	16	32 N.	6 W.	In town of Stella	R. XIV, p. 786. U.S.G.S. Bull. 540, pp. 38, 39, 50, 51.
Ganim	5, 8, 15	32 N.	6 W.	2½ miles NW. of Whiskeytown	R. XVIII, pp. 730-31; XIX, p. 11; XX, p. 15.
Garfield	34	33 N.	5 W.	2 miles E. of Copley	R. XI, p. 397; XIV, p. 787.
Gem Cons. Group		31 N.	5 W.	4 miles NW. of Redding	R. X, p. 632.
Gladys	34	32 N.	6 W.	10 miles NW. of Redding	R. XVII, p. 521.
Gladstone	1, 7, 8 12, 18	33 N. 33 N.	6 W. 7 W.	4½ miles NE. of French Gulch	R. VIII, pp. 568-69; X, p. 637; XI, p. 45; XII, pp. 248-49; XIII, p. 357; XIV, p. 787; XVIII, pp. 43, 96, 256; XIX, p. 11. U.S.G.S. Bull. 540, pp. 35, 37, 46, 57-60.
Gold Bar				4 miles NE. from French Gulch	R. XIII, p. 358.
Gold Bar No. 1-4	22, 26	33 N.	5 W.	10 miles N. of Redding	R. XIX, p. 93.
Golden Crown	19	31 N.	6 W.	2 miles NW. of Igo	R. XIV, p. 788.
Golden Queen Group				5 miles NW. of Redding	R. XVIII, p. 354.
Gold Leaf	5	31 N.	5 W.	4 miles E. of Redding	R. XIII, p. 358; XVII, pp. 521-22; XVIII, pp. 296, 298, 354, 406, 495; XIX, p. 11.
Gossan				3 miles W. of Delta Station.	R. XIII, p. 358.
Gray Eagle					See Sunny Hill.
Green				3½ miles W. of French Gulch	R. XII, p. 249; XIII, p. 358.
Grey Eagle	10	29 N.	10 W.	1 mile S. of Harrison Gulch	R. XIV, p. 789.
Gypsy Gold and Silver				2 miles SW. of Shasta	R. XII, p. 249; XIII, p. 358.
Halcyon	17	33 N.	7 W.	4 miles NE. of French Gulch	R. XIV, p. 789.
Hall's				10 miles NW. of Ono	R. XIII, pp. 358-59.
Happy Jack Group	28, 32, 33	31 N. 32 N.	6 W. 6 W.	10 miles E. of Redding	R. XIV, p. 770; XVII, p. 522.
Harrison Gulch					See Midas Mine.
Hartman				3½ miles N. of Stella	R. XII, p. 250; XIII, p. 359.
Hidden Treasure				8 miles NE. of Shasta	R. XII, p. 250; XIII, p. 359.
Highland	35	33 N.	6 W.		R. XIX, p. 136.
Highland	14	33 N.	7 W.	2 miles NE. of French Gulch	R. XIV, p. 789. U.S.G.S. Bull 540, p. 69.
Holman				2 miles SW. of Copley	R. XIII, p. 359.
Hope	8	32 N.	7 W	5 miles SW. of French Gulch	R. XIV, p. 790.

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY—Continued.

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
Hull and Murray				4 miles N. of Shasta	R. XII, p. 250.
Index Group	6	32 N.	6 W.	½ mile N. of Oak Bottom	R. XIX, p. 57.
Indiana				Near Copley	R. XIII, p. 359.
Inez	19. 20	32 N.	5 W.	¾ mile S. of Keswick	R. XIV, p. 790.
Iron Mask					See Bright Star.
Jackson					See Billy McCormick.
Janice Group	11, 12	32 N.	6 W.	3 miles NW. of Keswick	R. XVIII, p. 598.
Jerusalem	9	31 N.	8 W.		R. XIII, p. 360.
J. I. C.	13	33 N.	7 W.	3 miles NW. of French Gulch	R. XII, pp. 250-51; XIII, p. 360; XIV, p. 790.
Jim Fisk				3 miles N. of Igo	R. XII, p. 251; XIII, p. 360.
Joe Davis				11 miles W. of Ono	R. XIII, p. 360.
Jubilee	23	31 N.	6 W.	½ mile from Centerville	R. XIV, p. 790.
Jumbo	18	31 N.	5 W.	6 miles SW. of Redding	R. XVII, pp. 522-23.
Kit Carson	3	32 N.	5 W.	2½ miles SE. of Copley	R. XIV, p. 790.
Lacomia	1	35 N.	6 W.	7 miles W. of Delta	R. XIV, p. 790.
Last Chance					R. XVIII, p. 296.
Last Chance				2½ miles NE. of Igo	R. XII, p. 251.
Liberty	31 36	33 N. 33 N.	5 W. 6 W.	1½ miles NW. of Copley	R. XIV, p. 790.
Little Maud				7 miles from Shasta	R. XIII, p. 361.
Live Oak				4 miles N. of Redding	R. XIII, p. 361.
Lodi	16	31 N.	6 W.	3½ miles N. of Igo	R. XII, p. 252; XIII, p. 361; XIV, p. 791.
Lost Buck				6 miles NW. of Ono	R. XII, p. 252; XIII, p. 361.
Lucky Bart				16 miles W. of Delta	R. VIII, pp. 569-70.
McCarthy, Saeltzer and Smith				4½ miles NW. from Redding	R. XIII, p. 361.
Mad Mule	32	33 N.	6 W.	5 miles NW. of Stella	R. IX, p. 38; XI, p. 397; XII, p. 252; XIII, p. 361; XIV, p. 791; XIX, p. 11. U.S.G.S. Bull. 540, pp. 40, 42, 52-54.
Maduro	20	32 N.	5 W.	mile S. of Keswick	R. XIV, p. 792.
Manlove				3½ miles N. of Stella	R. XII, p. 252; XIII, p. 362.
Mascot					See West End Mine.
McCall	32	36 N.	5 W.	7 miles SW. of Delta	R. XIV, p. 792.
McKinnon	6	35 N.	5 W.	7½ miles W. of Delta	R. XIV. p. 792.
Mechado				3 miles NE. of Igo	R. XII, p. 252; XIII, p. 362.
Midas	3, 4, 10	29 N.	10 W.	52 miles SW. of Redding	R. XIV, p. 792; Pre. Rep. No. 8, p. 18.
Milkmaid and Franklin	17	33 N.	7 W.	3 miles from French Gulch	R. XIV, pp. 793-94; XVIII, pp. 43, 406-407; XIX, p. 11. U.S. G.S. Bull. 540, pp. 35, 61, 63, 64.
Miner's Dream				3½ miles S. of Shasta	R. XII, p. 252; XIII, p. 362.
Minneshasta	33	32 N.	5 W.	4 miles W. of Redding	R. XVII, p. 523.
Minnesota	1, 2	32 N.	6 W.	2 miles SW. of Copley	R. X, p. 635; XII, p. 255; XIII, p 363; XIV, p. 794.
Mt. Pleasant	32	32 N.	5 W.	1 mile W. of Redding	R. XIV, p. 794.
Mocking-Bird				14 miles SW. of Redding	R. XII, p. 253.
Moline				3 miles N. of Shasta	R. XIII, p. 362.
Mount Shasta	33	32 N.	6 W.	3 miles S. of Stella	R. XIV, p. 794. U.S.G.S. Bull. 540, pp. 39, 44, 46, 47-48.
Mtn. Monarch Group					See Happy Jack Group.
Mountain View	10	32 N.	5 W.	8 miles N. of Redding	R. XVIII, p. 354.
Mountain Top				5 miles W. from Redding	R. XIII, p. 362.
Morton and Bliss	1	33 N.	6 W.	6½ miles W. of Kennett	R. VIII, p. 564; XI, pp. 398-99; XIV, p. 794.
Murray	18	32 N.	5 W.	1½ miles N. of Keswick	R. X, p. 365; XII, p. 253; XIII, p. 362; XIV, p. 795.
Nellie and Annie	1, 2	33 N.	7 W.	5 miles N. of French Gulch	R. XIV, p. 795.
Nelson				7 miles N. of Stella	R. XII, p. 253; XIII, p. 362.
New Year and Australian				1½ miles N. of Shasta	R. XIII, pp. 362-63.
New York and Skylark	17	33 N.	7 W.	4 miles NW. of French Gulch	R. XIV, p. 795.
Niagara	1, 6, 7, 8, 15, 18	33 N.	7 W.	4½ miles from French Gulch	R. X, pp. 636-37; XI, p. 50; XII, p. 253; XIII, p. 363; XIV, p. 793; XVIII, pp. 43, 296; XX, p. 15. U. S. G. S. Bull. 540, pp. 35, 37, 44, 67.
North Star	18	31 N.	6 W.	4 miles NW. of Igo	R. XII, p. 253; XIV, p. 798.
North Star	9	33 N.	7 W.	25 miles SW. of Redding	R. XVII, p. 523.
North Star	6	32 N.	6 W.		R. XVII, p. 523.
Old Massachusetts Group					R. XVIII, p. 495.
Old Spanish	31	32 N.	5 W.	2 miles W. of Redding	R. XII, pp. 246-47; XIII, p. 353; XIV, p. 796.
Olive	19	32 N.	5 W.	1½ miles SW. of Keswick	R. XIV, p. 796.
Oro Fino	34	32 N.	6 W.	1 mile E. of Shasta	R. XI, p. 44; XIV, p. 796.
Oro Vista	36	32 N.	6 W.	½ mile SE. of Shasta	R. XIV, p. 796.

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY—**Continued.**

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
Peerless Group	23	31 N.	6 W.	8 miles SW. of Redding	R. XII, p. 245; XIII, p. 349; XVIII, pp. 598-99.
Potosi	15	31 N.	6 W.	1½ miles NW. of Centerville	R. XII, p. 254; XIII, p. 363; XIV, p. 796.
Pugh and Lindsay				3 miles W. of Shasta	R. XII, p. 254; XIII, p. 363.
Quartz Hill					See Cons. Kascinaska.
Rattler					See Minnesota.
Rawhide	19	32 N.	5 W.	2½ miles from Keswick	R. XVII, p. 523.
Red Bluff				15½ miles NW. of Ono	R. XIII, p. 363.
Red Cloud				4 miles W. of Igo	R. XII, p. 255; XIII, p. 363.
Reid Mine	3	32 N.	5 W.	8 miles N. of Redding	R. XIV, p. 797; XVIII, p. 408; XIX, p. 11; XX, p. 15.
Remonia, D. and B.					See Colorado.
Reservoir and Offset					See Black Cloud and Red Cloud.
Richmond				3½ miles W. of Igo	R. XII, p. 256; XIII, p. 364.
Rickard				5½ miles W. of Delta	R. XIII, p. 364.
Riley and Bliss					See Morton and Bliss.
Ruby and Pearl	4	38 N.	5 W.	12 miles W. of Castella	R. XIV, p. 797; XVIII, p. 354; XIX, p. 11.
Sam Housten	34	33 N.	5 W.	2 miles E. of Copley	R. XIV, p. 797.
Sanders and Vollmer				5½ miles W. of Delta	R. XIII, p. 364.
Scottish Chief	31	33 N.	5 W.	½ mile NW. of Copley	R. XIV, p. 797.
Shasta View (Bonanza Gold Dollar)				2 miles N. of Shasta	R. XVIII, p. 256; XX, p. 15.
Siskiyou and Nightingale	2	35 N.	6 W.	7 miles W. of Dog Creek railroad	R. XIV, p. 798.
Slatonas				4 miles W. of Delta	R. XIII, p. 364.
Slide	7, 8	32 N.	5 W.	1 mile N. of Keswick	R. XIV, p. 799.
W. W. Felts and I. Smith					See Jumbo Prospect.
South Star Mine	32	33 N.	7 W.		R. XVIII, p. 256.
Spardy				2½ miles SW. of Copley	R. XII, p. 257; XIII, p. 364.
Spring Gulch				7½ miles NW. from Stella	R. XII, p. 257; XIII, p. 364.
Surprise Gold Mining and Milling Company				1¾ miles N. of Shasta	R. XII, p. 257.
Summit					See Sunny Hill.
Summit & Montezuma	17	33 N.	7 W.	5 miles W. of French Gulch	R. X, p. 641; XIII, p. 365; XIV, p. 799; XVIII, pp. 206, 256.
Sunny Hill	1	30 N.	8 W.	7 miles W. of Ono, 25 miles SW. of Redding	R. XII, p. 257; XIII, p. 365; XIV, p. 799.
Sybel	7	33 N.	7 W.	5 miles NW. of French Gulch	R. XIV, p. 777; XVIII, pp. 43, 138, 296, 408; XIX, p. 11. U.S. G.S. Bull. 540, pp. 68-69.
Tanglefoot	12	30 N.	8 W.	8 miles SW. of Ono	R. XIV, p. 799-800.
Texas Cons.	32, 33	33 N.	5 W.	1 mile E. of Copley, 9 miles N. of Redding	R. X, pp. 629-30; XI, pp. 43, 396-97; XII, p. 258; XIII, p. 365; XIV, p. 800; XVIII, p. 206; XIX, pp. 11, 58, 137.
Thompson				2½ miles SW. of Shasta	R. XII, p. 258; XIII, p. 367.
Three Sisters	15	33 N.	7 W.	2 miles NW. of French Gulch	R. XIII, p. 367; XIV, p. 800.
Tom Green Mine	15	33 N.	7 W.	5½ miles W. of French Gulch	R. XIV, p. 800.
Topknot				5½ miles from Delta	R. XIII, p. 367.
Trinity Cons.	1, 2	35 N.	6 W.	West of Delta	R. VIII, p. 569; XIII, p. 367; XIV, p. 802. U.S.G.S. Bull. 540, pp. 35, 37, 54, 55.
Truscott	25	32 N.	7 W.	6 miles NW. of Stella	R. VIII, pp. 571-72; XII, p. 248; XIII, p. 356; XIV, p. 802.
Uncle Sam	1, 6	33 N.	6 W.		R. X, pp. 639, 310; XI, pp. 47, 395, 398; XII, pp. 258-59; XIII, pp. 367-68; XIV, pp. 802-803; XIX, p. 56; XX, p. 15.
Utah and California	3, 4	32 N.	5 W.	2 miles SE. of Copley	R. X, pp. 630-31; XI, p. 397; XII, p. 259; XIII, p. 368; XIV, p. 803.
Victor	3	29 N.	10 W.	In the town of Harrison Gulch	R. X, pp. 635-36; XI, p. 50; XII, p. 260; XIII, p. 368; XIV, pp. 803-804. U.S.G.S. Bull. 540, pp. 35, 37, 44, 64-66.
Walker					See Utah and California.
Walker's, Frank				4 miles W. of Redding	R. XVIII, p. 296.
Washington	16, 17	33 N.	7 W.	3 miles NW. of French Gulch	R. X, pp. 635-36; XI, p. 50; XII, p. 260; XIII, 368; XIV, p. 804; XVIII, p. 43; XIX, p. 11. U.S. G.S. Bull. 540, pp. 35, 37, 44 64-66.

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY—Continued.

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
West End	16	32 N.	6 W.	1 mile SE. of Whiskeytown.	R. XII, p. 260; XIII, p. 368; XVIII, pp. 96, 256, 295-96; 409-10; XIX, p. 11.
Western					See Milkmaid and Franklin.
West Point				3½ miles from Shasta	R. VIII, p. 570; XII, p. 260; XIII p. 368.
White Oak				2½ miles NE. from Shasta.	R. VIII, p. 571.
World's Fair				2½ miles NW. of Igo	R. XII, p. 260; XIII, p. 368.
Williard and Williams	19	32 N.	5 W.	1 mile E. of Keswick	R. XVII, p. 523.
Yankee John		31 N.	5 W.	6 miles SW. of Redding	R. XVII, p. 524; XVIII, p. 495; XIX, p. 11.
Yellow Jacket				3 miles NE. of Copley	R. XII, p. 260; XIII, p. 368.

GOLD (PLACER MINING).

The streams of Shasta County drain into Sacramento River and placer mining along them is therefore subject to debris restrictions. There has been no hydraulic mining in the county for many years past, although some gravel suitable for working by this process remains in the Clear Creek drainage, near French Gulch, and a larger acreage in the Igo district. The prospective placer gold production will be principally from this stream.

The productive placer mining sections of the county were nearly all west of Sacramento River, as the streams entering the river from the east drain formations which carry little gold, being either barren sedimentary rocks or recent, unmineralized lava. Besides Clear Creek, the next most important placer mining operations in late years were along Cottonwood Creek, which is the county line between Shasta and Tehama Counties west of Sacramento River. Smaller streams such as Oregon Gulch and Olney Creek were rich in early days. Hazel Creek and a small area on Montgomery Creek carried about the only gold-bearing gravel east of Sacramento River.

The conglomerate on the eastern shore of the Cretaceous Island of northern California supplied gold and platinum to the later streams, notably to sections of Clear Creek and the northerly tributaries of Cottonwood Creek. These conglomerates occur in the southwestern part of the county, passing west and southwest from Redding to the Igo and Ono districts, and to the Bald Hills and Beegum Peak, the latter being a prominent landmark covered by the conglomerate.

While there are large accumulations of gravel north of Redding, both in bars along Sacramento River and as ancient high shore gravels, mining of these has been, on the whole, disappointing, as mentioned under dredging.

The known available placer ground, not counting the numerous small diggings where one or two men working alone sometimes make a "strike," consists of 2000 to 3000 acres in the Igo district; a few hundred acres along Clear Creek 3½ to 4 miles north of French Gulch, including such land as the Robert Williams and George Martin properties, the latter now being worked by Jenkins and Taylor; perhaps 250 acres on Clear Creek near Horsetown; some land on Roaring River near Gas Point, which has lately been noticed as a dredging possibility; some unprospected and very indefinite possibilities in the Anderson district; and small areas along Sacramento River which might be selected from such large holdings as that abandoned by American Dredging Company.

GOLD (DRIFT MINES).

Grubstake Placer Mine. Owners, Nelson Brothers, La Moine, California. Property is in Sec. 22, T. 36 N., R. 5 W., in the Slate Creek mining district, one mile south of La Moine. It is in the Shasta National Forest and contains a small amount of oak, pine and fir. Elevation 1260 feet. The claim was located in 1917 and contains 80 acres. Country rock is slate. Deposit consists of sloping gravel bars. The gravel channel being worked courses north and south, the gravel varying from 1 to 46 feet in depth. There is no cement, but boulders up to four tons are encountered. The slate bedrock is full of holes and crevices. Width of pay gravel about 40 feet and depth 30 inches. The portion of the claim being worked is located on a high bluff about 40 feet above the present river level. Here the gravel is about nine feet deep. The top dirt is moved to one side and the pay dirt moved out and dumped into a chute and run down to the river level, where it is washed in sluice boxes. Only worked in the winter on account of scarcity of labor and high wages.

Bibl: Cal. State Min. Bur. R. XVII, p. 525.

Hardscrabble or Piety Hill Mine was formerly a good producer. It covers 1700 acres of patented land in the Igo district, containing high gravel deposited by the ancient stream corresponding to Clear Creek. This property was worked previous to 1880 as a hydraulic mine, and afterward by drifting. At present it belongs to Happy Valley Land & Water Company, who are using the old ditches and water formerly employed in hydraulic mining, for irrigation. The mine has been idle for many years. The gravel is 50 feet deep in places but averages 20 feet.

Lost Channel Mine. The property lies immediately south of the Clear Creek drainage in the Igo mining district, 12 miles southwest of Redding. Holdings consist of 580 acres, located in sections 34, 3 and 4, T. 31 and 30 N., R. 6 W. Elevation is 1100 feet. Owner, C. A. Russell of Igo. The 'channel' is in all probability a section of the ancient bed and wash of Clear Creek. The width of this old channel is from one-half to fully one mile across. The present drainage of Upper Dry Creek passes directly across the course of the old channel in a southwesterly direction. Deepest depth of the channel is 80 feet.

Character of bedrock: At the northern end of the property, the wash overlies the slates and tuffs. For a distance of about one mile southwesterly, a soft decomposed granite bedrock exists, lying between the slates and sandstones. The sandstone is on the southerly end of the property.

Developments: On the south side of Dry Creek, there is fully 7000 to 8000 feet of workings near the Dunham tunnel. Since Report XIV (p. 791), the ground was prospected by a series of drill holes sunk on the north township line, 100 feet apart to a depth of 50 to 65 feet. North of the Dunham tunnel, 12 prospect shafts were sunk, 200 feet apart, east and west across the channel, the depth of these shafts to bedrock being from 18 to 80 feet. Gravel tested ran from 4 to 60 cents per cubic yard, the average value being 12 cents per yard. The ground east and west of Harrison Gulch averaged 50 cents per cubic yard. Three channels have been developed, known as East, West, and Tom White. General course of the channel is north and south. In recent development work, a shaft has been sunk 34 feet deep to bedrock on Los Angeles Gulch. This shaft is one mile north of the Dunham tunnel. To the south of this shaft, two other shafts have been sunk to bedrock. These three shafts are 100 feet apart. Gravel from these three shafts averaged 32 cents per cubic yard. Present work is confined to drifting south on the channel. The gravel mined in the south drift for a height of two feet above bedrock, averaged $10 per cubic yard.

Character of Gold: Very little gold is shown of a size that could be classed as small nuggets except in the main channel, and in the present workings. The distribution in the general wash shows gold running about 10 colors to a cent on an average. Fineness, 0.873. Total production is reported to be $3,000,000 from 1865 to the present time.

Equipment: Consists of 2-h.p. Fairbanks-Morse gas engine which drives hoist, rod pump and washing machine. Capacity of washer is 30 tons per 24 hours. Two men are employed in 1926, drift mining.

Bibl: Cal. State Min. Bur. R. XVIII, p. 599.

Woodfill Placer adjoins Lost Channel Placer on the same deposit. Idle. Geo. Woodfill, Igo, owner.

GOLD (DREDGING).

Extensive deposits of auriferous gravel occurred along Clear Creek for a distance of 7½ miles from the mouth of its rocky canyon to Girvan, on the railroad below Redding. This section has been dredged for many years past and still contains some ground on which a dredger is being built at present (April, 1926).

William Diestelhorst was the pioneer dredger operator, using a steam scoop which is said to have been successfully worked for several years. In 1906, Shasta Dredging Company installed a dredger and operated for several years until their ground was exhausted. They worked up as far as the Gleason holdings, which are near the beginning of the canyon. Subsequently, several Oroville companies drilled the creek but did not operate. Lawrence Gardella later installed a dredger below the Shasta Dredging Company's land and continued work until the dredger was burned last year. The gravel is free washing, medium to small size and as much as 20 to 22 feet deep, but averages 12 to 15 feet. The deposit is one-fourth to one-half mile wide in places and bedrock was favorable for dredging, except in places where hard high reefs cross the stream and have prevented moving the dredger.

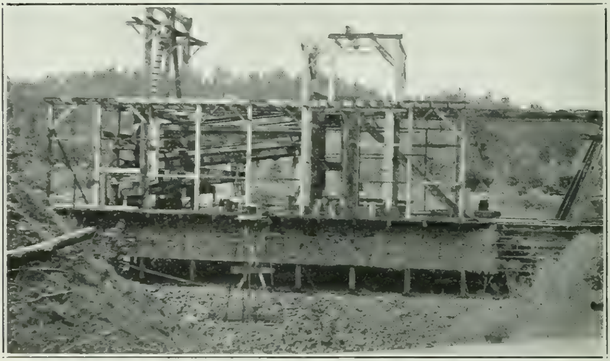
American Gold Dredging Company. (See under Sacramento River.)

Big Chief and Little Chief Placer Claims are on Clear Creek near old Horsetown, about 6½ miles by road from Girvan. Wm. L. and Helen M. Hill of Redding have given an option to purchase to Fred C. Anderson, who plans to put a P. & H. gasoline shovel on the claims to work the gravel. Fifteen holes to an average depth of 20 feet are said to have given very satisfactory prospects.

Gleason Estate Placers are in SE$\frac{1}{4}$ of Sec. 36, T. 31 N., R. 6 W., on Clear Creek at old Horsetown, seven miles by road west of Girvan. James Gleason, Elizabeth Schroter and other Gleason heirs have recently agreed to sell the holdings, containing 110 acres, to Lawrence Gardella of Oroville for dredging.

The land lies near the upper end of the dredgable area, and the gravel is mostly fine to medium sized, 12 to 22 feet deep and about one-fourth mile wide where the creek spread out in past years over the flood plain, parts of which are now covered by a few feet of soil.

Gardella has just completed a wooden dredger hull 36′ by 72′, on which will be installed machinery from dredgers formerly operated by him on Clear Creek and elsewhere. He has shops and a camp 2$\frac{1}{2}$ miles downstream. It is believed the dredger will be ready for operation about June first.



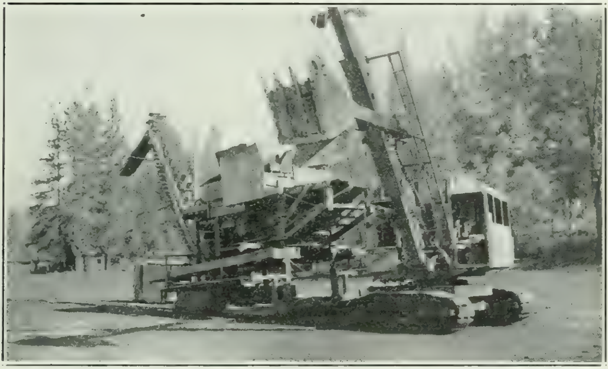
Wooden hull of Gardella dredge, under construction at Horsetown on Clear Creek.

Gold Bar Placers, belonging to Wm. L. and Helen M. Hill of Redding, adjoin the Gleason Estate property upstream and contain 60 acres on Clear Creek. These claims have also been taken under option by Lawrence Gardella for dredging. The ground is similar to the Gleason property.

Jenkins & Taylor Placer. Owners, E. H. Jenkins and Charles Taylor, San Luis Obispo. Property is on Clear Creek 3$\frac{1}{2}$ miles north of French Gulch and includes the George Martin Ranch and Drunken Gulch Placer Mine, a total of 140 acres.

The gravel along the stream and on the old back channels averages about 13 feet deep. There is a large area remaining unworked, probably two-thirds of the total acreage.

The present operators installed a P. & H. three-fourths yard gasoline shovel operated by a 65-h.p. engine, and have done extensive preliminary work, including some prospecting pits and a sluiceway across the property, through which Clear Creek can be diverted by damming it at the upper end of a large bend. For washing gravel, they have installed a Pierce Gold Machine, which is a small dry-land outfit patterned after one used in the placers near La Panza, where water is scarce. It carries a trommel about 4 feet by 16 feet, with three-fourths inch screen, through which fine gravel discharges on each side into four apron sluices 2½ feet by 4 feet, thence to 30 feet of sluice 2½ feet wide with Hungarian riffles. Coarse cobbles pass through the lower end of trommel to a bucket elevator with buckets two feet wide which is capable of stacking rocks 20 feet high or more. In operation, this machine is dragged around on skids by the gasoline shovel, which feeds gravel into the hopper. Power for the Pierce machine is furnished by a second-hand automobile engine working through chain and gear drives. A six-inch centrifugal pump supplies water for washing.



P. & H. gasoline steam shovel and Pierce gravel gold washing machine on Jenkins and Taylor Placer, near French Gulch. Photo by courtesy of Clifford Taylor.

The ground is stated to prospect very well in gold and is free-washing, with wash mostly small and medium sized but some large boulders. The gasoline shovel is adapted to work such ground. The working capacity will be limited by the gravel washing machine and by the necessity for frequent moves.

Sacramento River.

Numerous attempts have been made to dredge the gravel of Sacramento River just northeast of Redding. Several small suction dredgers were tried without much success. Early in 1918, *American Gold Dredging Company* built a dredger with buckets of six cubic feet capacity designed to dig 40 feet below water level. They operated intermittently during the next five years but later abandoned the property. This work was on the Menzel Ranch, containing 1000 acres along the north bank of the river opposite Redding. The ground was mostly suitable for dredging, and was 20 to 40 feet deep, with medium sized gravel, but it evidently did not come up to the grade indicated by drill prospects. William Diestelhorst, the pioneer dredger operator on the Sacramento River, found some good ground but states the gravel along the river is very spotty and much of it very low grade.

IRON.

Iron ore occurs in Shasta County at several places along the contact of the McCloud (Carboniferous) limestone and quartz-augite-diorite of late Jurassic or early Cretaceous age.* The principal outcrops noted are a mile and a half north of Heroult, where considerable ore has been mined; on the northeast side of Hirz Mountain; and on the north and west sides of Gray Rocks.

The deposits show limonite on the surface, but magnetite deeper, and are of the contact type. In places, pyrrhotite and chalcopyrite occur with the magnetite and this led to the belief that the deposits might prove on development to be the gossan of copper ore bodies.

A technically successful method of electric smelting of iron ores and alloys was followed at Heroult by Noble Electric Steel Company for several years.

California Consolidated Iron Mines. Owners, Ida Bass, E. M. Eaton, M. A. Gleaves, F. A. Forsythe and F. A. Forsythe, Jr. Contain 88.6 acres in Sec. 26, T. 34 N., R. 4 W. Idle, undeveloped.

Jennings Group. Owner last known, J. J. Jennings, Baird. Eleven claims, containing 220 acres, in Secs. 7 and 8, T. 35 N., R. 3 W., nine miles by road from Antler, and can also be reached by an old road, partly in bad condition, up McCloud River from Sacramento Valley and Eastern Railroad. The claims are on the northeast side of Hirz Mountain.

The claims were located in 1903 for gold, silver, copper and iron. Considerable prospecting work, consisting mostly of short adits and open cuts, was done and while all of these minerals are said to occur, the deposits are characteristically limonite and magnetite, of good grade, and have been estimated to contain 1,000,000 tons or more. Copper and iron sulphides in small amount are reported at 100 feet in depth. Idle.

Noble Electric Steel Company owns one-half of Sec. 21, the SW$\frac{1}{4}$ of Sec. 25, 80 acres in Sec. 35 and 94 acres in Sec. 26, all in T. 34 N., R. 4 W., near Heroult. The electric smelting plant has been idle since the war, but the processes used for producing charcoal pig iron, and later ferro-manganese and ferro-silicon are of interest technically and also in a general way as indicating the possibilities for such an industry in the future. While the products of this plant were of high quality, operation was costly and electricity in particular would have to be obtained at much lower cost than formerly available to make the process a financial success permanently in normal times.

---

* Diller, J. S., U. S. Geological Survey, Folio No. 138, Redding.

The furnaces were rectangular shells, 10 feet wide by 25 feet long by 8 feet high, lined with silica brick. Four carbon electrodes each 12 inches in diameter were suspended above the furnace, entering vertically. Furnaces were equipped with gravity feed. The different constituents of the charge were drawn from the respective bins into the scale car, which was dumped into a chute, the charge mixing as it fell to the furnace, where it was hand spread.

The plant was built about 1907 and until 1914 produced pig iron. Charcoal, barren quartz and limestone, and iron ore from the nearby Shasta Iron Company's claims, were charged together into the furnace, and a superior quality of pig iron, very low in sulphur and phosphorous and carrying from 1% to 5% silicon, was obtained. The daily capacity was 25 tons, with a crew of 12 men. Each of the electrodes used 1500 kilowatts of electricity.

After the war started, the making of ferro-manganese and ferro-silicon was begun. The manganese used was from mines in various parts of the state and the average analysis of it was:

Manganese (Mn)	40%
Silica (SiO_2)	16%
Iron (Fe)	1% to 3%

Phosphorus and sulphur low or absent.

The local iron ore used carried 68% iron and 1% to 2% silica.

The furnace charge for making ferro-manganese was about as follows:

2000 lbs. manganese ore.
800 lbs. limestone.
60 lbs. fluorspar.
70 lbs. iron ore.
550 lbs. charcoal or coke (crushed fine).

The ferro-manganese produced averaged

For 70% product		For 80% product
70%	manganese	80%
20%	iron	12%
6%	carbon	6%
1% to 3%	silicon	1% to 3%

Phosphorus and sulphur absent or only traces.

Metal was tapped every three hours, at a temperature of 1400° C. and each furnace produced seven to eight tons of ferro-manganese in 24 hours. A recovery of 65% to 70% of the manganese in ore was made. This type of furnace could use coke made from petroleum residue, as no great strength was needed, and this material was used when obtainable. The high cost of coke from other sources and the cost of manganese ore were also big factors in cost of production.

For making 75% ferro-silicon, the following charge was used:

2000 lbs. siliceous material (85% SiO_2, 5%–10% Fe).
1000 lbs. charcoal.
400 lbs. iron ore (68% Fe, 1% to 2% SiO_2)

This was tapped at 1550° C.

The enterprise was unable to survive the post-war adjustment period, but was a pioneer work worthy of attention from those seeking to develop the county's resources.

Peterson Group. (*Deep Pit Group.*) Owner T. H. Peterson, Heroult. There are 14 claims in Sec. 36, T. 34 N., R. 4 W., on south side of Pit River, one-half mile south of Heroult. They cover a large iron gossan. 500 feet wide by a mile long north and south. A number of short adits have been run, and are reported to show some pyrite and copper. The surface ore is considered valuable for mineral paint but none has been marketed yet, although the owner is reported to have had various offers.

Shasta Iron Company Group. (*Pit River Iron Ore Mines, Magnetic, Ydalpom, Wintoon No. 1,* and other claims.) These comprise 174 acres patented and six unpatented claims in Sec. 26. T. 34 N., R. 4 W., owned by Shasta Iron Company and operated under lease by Noble Electric Steel Company, 384 Mills Building, San Francisco, until about April, 1925.

The last named company operated intermittently for the first few years after the closing of their electric smelter, but for several years past and up to a year ago, had been shipping ore quite steadily and in considerable quantity to Pacific Coast furnaces. It was the principal producer of the state during that time.

The iron ore, which occurs as limonite on the surface and magnetite below, follows the irregular contact of McCloud limestone and quartz-augite-diorite, in a northeasterly direction. The orebody developed by numerous open cuts and adits is 1000 feet long by 150 feet wide and is estimated to contain 1,000,000 tons. The ore mined in the past seven years has contained 65% to 68% iron, 1% to 3½% silica, .02% sulphur and .012% phosphorus.

The mine was worked by two open quarries 140 feet apart in elevation. From the lower quarry it was trammed to the head of a gravity tram 1600 feet long, which delivered it to the railroad cars at Heroult, on the Sacramento Valley and Eastern Railroad. Besides shipping 10 to 15 cars of ore a month during their later operations, this company supplied 1500 tons of ore from which steel was made for the towers on the high-tension electric transmission lines from Pit River southward.

Bibl: Cal. State Min. Bur. R. XII, p. 327; XIV, pp. 805–806; Bull. 38, pp. 301–304. U. S. Geol. Survey, Redding Folio; Bull. 213, pp. 130, 219; Bull. 225, p. 178.

LEAD.

Lead has been produced in small quantity as a by-product from copper and silver ores. A few small prospects containing galena as the principal ore have been worked a little the past two years near the highway north of Ingot and near Round Mountain. The prospects visited are in Triassic limestone.

Asher Prospect (*Jacksonian* and other claims). Owners, James G. Asher and George S. Burns, Ingot. Under lease and option to C. A. Hill and Charles Walters, Ingot. There are four unpatented claims. adjacent to the highway two or three miles north of Ingot.

A prospect shaft sunk just below the highway was full of water when visited. There was a small quantity of ore, carrying galena with a little zincblende, on the dump. The incline shaft was said to be 60 feet deep.

Cartwright Prospect. Owner, E. Cartwright, Round Mountain via Ingot. This is a lead prospect in Round Mountain district. The owner is working it.

Highgrade Lead Prospect. Owners, E. Cartwright, Ingot, and Hamilton and Morris, Chico. In E½ of NW¼ of Sec. 27, T. 34 N., R. 1 W.

A vein carrying galena and zinchblende in about equal proportions, so far as could be judged from observation of the accessible section of it, strikes N. 18° E. and dips 30° W. Both walls are gray limestone and show gouges one-half inch wide.

The property was idle when visited and a 2-compartment inclined shaft was full of water within a few sets of the surface. South of this a few feet, the vein is six inches to a foot in width and carries a fair amount of galena and zincblende.

A small mill was built on the claim adjacent to the shaft a year or so ago but it is not known that any shipment of concentrate has been made.

LIMESTONE.

This mineral is said to occur more abundantly in the Redding quadrangle than in any similar area on the Pacific Coast. The McCloud (Carboniferous) limestone begins with small lenses near Lilienthal, eight miles northeast of Redding, extending thence northerly past the Baird fish hatchery, where the deposits are large and most conveniently located for working, and into the less accessible region of the upper McCloud river. Other deposits of Devonian age are found two to four miles west and northwest of Kennett. Limestone was produced for many years from the latter locality to supply smelter flux and lime for other local uses, but no work is going on now. Smaller bodies of it are also found in different parts of the county. The Hosselkus (Triassic) limestone is prominent east of Ingot and on Brock Mountain north of Pit River. Some of this was used for smelter flux at Ingot.

The McCloud limestone appears to be of greater prospective interest than the others because of the accessibility and size of the bodies near the fish hatchery. These bodies cover part of Sec. 12, nearly all of Sec. 13 and parts of Secs. 14, 23, 24 and 26, T. 34 N., R. 4 W., as well as parts of Secs. 6, 7, and 18, T. 34 N., R. 3 W. Of these, the more accessible holdings are those on the west and south sides. The Gray Rocks are in Sec. 3, T. 33 N., R. 4 W., from one-half to 1½ miles south of Pit River and slightly closer to the railroad than the others.

The general description of this formation by Diller* will suffice for the various holdings.

"The limestone is dark gray and massive below, and somewhat thinner bedded above, with many nodules and sheets of gray chert, often containing silicified fossils.

"The largest and most accessible exposures of the McCloud limestone are at Gray Rocks, near Bayha * * * and opposite the United States fishery. The two localities are separated by quartz-augite, which cuts the limestone."

"* * * For 10 miles beyond Pit River the escarpment of McCloud limestone forms one of the principal topographic features, but it is very much cut up by quartz-augite-diorite into irregular patches of limestone separated from one another by distances varying from a few feet to over two miles. * * * The largest mass is that opposite the fishery.

---

* Diller, J. S., U. S. Geol. Survey, Folio No. 138, Redding, p. 3.

"* * * In thickness, the McCloud limestone varies from 200 feet or less near the south end * * * to approximately 2000 feet in the prominent rugged mountain formed by it a short distance northeast of the fishery."

The principal holdings in this district are noted below. The properties mentioned are the most accessible, and would naturally be the first developed. Besides these, there are other limestone areas adjacent, but harder to reach, which are partly in unpatented land, or in Indian allotments or railroad sections.

Bayha Land Company (Lime Mountain Consolidated) owns a large part of the Gray Rocks Deposit in the E½ of Sec. 3, T. 33 N., R. 4 W., and in Sec. 2 adjoining, a little over a mile south of Pit River. The Sacramento Valley and Eastern Railroad, which connects with the main line of the Southern Pacific Railroad near the mouth of Pit River, passes along the north bank of the Pit here, making this deposit the nearest to transportation. It stands several hundred feet above the river.

Estate of D. P. Doak owns the SE¼ of Sec. 23, T. 34 N., R. 4 W., largely covered by limestone, and lying one-fourth to one-half mile southeast of the United States fish hatchery. This is a large body, conveniently situated and about two miles north of the Sacramento Valley and Eastern Railroad. Adjacent to it, Shasta Iron Company operated a limestone quarry on the south end of deposit in Sec. 26 for years.

Moxley Deposit. Cora Lee Moxley, owner. This comprises all of fractional Sec. 13, T. 34 N., R. 4 W., containing 622 acres. Practically all of the section except part of the southeast quarter is covered by limestone as mapped by the U. S. Geological Survey, culminating in a mountain 3114 feet high. It is 2½ miles north of the Sacramento Valley and Eastern Railroad. The lower, western part of this immense deposit is owned by Shasta Cement Materials Company. The contact of limestone on the west with quartz-augite-diorite is at about 1500 feet elevation, and about 700 feet above and one-half mile east of McCloud River, so it can be seen that by starting a quarry on the west edge of deposit, backs of 1600 feet would ultimately be had. Estimating average backs of 1000 feet for one-half the area, the immense total of over 1,000,000,000 tons of available limestone would be indicated. Actually the amount no doubt exceeds this.

The following is a reported analysis of limestone from the deposit:

Silica (SiO_2)	1.10%
Iron oxide (Fe_2O_3)	0.20%
Calcium oxide (CaO)	52.16%
Magnesium oxide (MgO)	2.38%
Aluminum oxide (Al_2O_3)	0.24%
Ignition loss	43.96%
	100.04%
Indicated calcium carbonate	93.20%

This analysis agrees with quoted analyses from the quarry in Sec. 26, where large tonnages have been shipped over a period of years to smelters.

Between this property and the river there is a good plant site (see photo). The nearest sub-station from which electric power could be obtained is at Heroult, on Pit River about three miles south, where Noble Electric Steel Company formerly operated electric iron smelting furnaces. A large shale deposit covering parts of three sections lies 2½ miles west and is conveniently located for cheap operation.

Shasta Cement Materials Association. M. E. Dittmar, Crocker Building, San Francisco, president. R. M. Saeltzer, Redding, secretary. The company owns 320 acres, unpatented, in Secs. 14 and 23, T. 34 N., R. 4 W., on which is found the western part of the large limestone deposit described under Moxley, and 320 acres, patented, in Sec. 16, T. 34 N., R. 4 W., where shale suitable for cement making occurs as well as limestone. A good plant site, between the first mentioned limestone beds and McCloud River, is also owned.

This property appears to be the logical starting place for the development of the limestone deposits nearby as it covers a frontage of a mile and a half from which work would be most conveniently begun. (See photo.) The limestone rises to a height of several hundred feet in the eastern part of Sec. 14, comprising the lower slopes of the limestone mountain. There is a large tonnage of stone available on the property.

The shale holdings in Sec. 16 have been estimated by M. E. Dittmar to contain about 200,000,000 tons of shale, and the following is an analysis of it reported to have been made by Smith, Emery and Company:

Silica (SiO_2)	57.51%
Iron oxide (Fe_2O_3)	8.28%
Calcium oxide (CaO)	2.98%
Magnesium oxide (MgO)	2.61%
Titanium oxide (TiO_2)	0.81%
Manganese oxide (Mn_3O_4)	1.34%
Aluminum oxide (Al_2O_3)	19.85%
Ignition loss	4.46%
Alkalies (by difference)	2.16%
	100.00%

Only assessment work has been done on the unpatented limestone claims and no work has been done on the shale, which was purchased in 1924 from the state.

Shasta Iron Company owns a large limestone deposit adjoining their iron mine in N½ of Sec. 26, T. 34 N., R. 4 W., 1¾ miles north of the Sacramento Valley and Eastern Railroad. This is the southern part of the deposit mentioned under Doak.

This limestone property is the only one in the district that has been developed commercially. A quarry face 200 feet long by 100 feet high was opened and limestone was shipped to Bully Hill for flux while the smelter was in operation. At present it is idle. This quarry was at the same elevation as the lower iron quarry, and the stone was delivered

The McCloud limestone deposits from the U. S. Fishery pond at Baird, Shasta County, California. Lower slopes on claims of Shasta Cement Materials Association. High mountain on left is the Moxley limestone property. Shows also other holdings. Photo by courtesy of M. E. Dittmar.

to railroad cars at Heroult over a gravity surface tram line 1600 feet long.

The following is an analysis of the limestone, quoted by Tucker:[1]

Silica (SiO_2)	1.02%
Alumina (Al_2O_3)	0.61%
Magnesia (MgO)	1.12%
Calcium oxide (CaO)	53.80%
Iron oxide (FeO)	0.20%
Carbon dioxide (CO_2)	43.25%
	100.00%

Other Limestone Deposits.

Some small quarries have been operated in the past to supply the copper smelters with flux and to fill other local demands. Chief among these was the Holt & Gregg in Sec. 34, T. 34 N., R. 5 W., two miles northwest of Kennett, the railroad shipping point and smelter site. Lime was burned here for years for commercial uses and large amounts of limestone were also sold to the Keswick and Kennett smelters. With the closing and dismantling of both of these smelters, the principal local market is gone.

Another large limestone bed of same age as the last mentioned lies in Sec. 22, T. 34 N., R. 5 W., two to 2½ miles west of the main line railroad, and a third and smaller deposit lies in Secs. 32 and 33, between Little Backbone and Squaw Creeks. These deposits (and a number of other smaller ones, which will not be listed because too remote from the railroad to compete with the above) are coral limestone of Devonian age, and differing from the McCloud beds. It is said to make good lime.

The following is a reported analysis of the Devonian limestone:[2]

Calcium carbonate	95.2%
Silica	4.4%
Magnesia	0.5%
Organic carbon	Trace

The Briggsville (Moorestown) Limestone Quarry is on Clear Creek, six miles by road west of Girvan, in N½ of Sec. 31, T. 31 N., R. 5 W. Years ago an old stone kiln using wood fuel was built here, but evidently little lime was burnt. J. H. Hill, Redding, re-located the property and in 1925 sold a few hundred tons of slacked lime for agricultural use.

A lens of limestone nearly 100 feet thick outcrops conveniently for quarrying on the slope near the roadside. The exact size of the deposit can not be judged because it dips into the hill and farther back is covered by overburden.

BIBLIOGRAPHY OF LIMESTONE DEPOSITS.

California State Mining Bureau publications: Reports IV, p. 112; VI, p. 98; VIII, p. 572; X, p. 627; XI, pp. 35, 37, 48; XII, p. 395; XIII, p. 632; XIV, p. 806; XVIII, p. 733; XIX, pp. 12, 69–71. Bulletin 38, pp. 88–91. Vol. 1 (Whitney Survey), Paleontology of California.

United States Geological Survey Publications: Bulletins 196, p. 94; 213, p. 365; 225, p. 176. Redding Folio, No. 138 (Redding Quadrangle maps and text).

---

[1] Cal. State Min. Bur. R. XVIII, p. 733.

[2] Cal. State Min. Bur. R. VIII, p. 572.

Limestone deposit and plant site of Shasta Cement Materials Association on McCloud River and in background, part of other limestone holdings. Photo by courtesy of M. E. Dittmar.

MANGANESE.

Low-grade manganese prospects were found on the *Pit River Consolidated* claims in Sec. 1, T. 33 N., R. 4 W., and Sec. 36, T. 34 N., R. 4 W., a mile southeast of Heroult smelter, and in the vicinity of the Peterson Group of claims. In 1917, Noble Electric Steel Company leased the claims and experimented with the material in the manufacture of silico-manganese, but found it unprofitable. The deposit consists of manganese oxide filling joint planes and cracks in schist, and carried 20% to 28% manganese, 23% to 37% silica and 6.7% iron.

Manganese prospects are also reported near Pit River in the vicinity of the Exposed Treasure Barite claims in the southwestern part of T. 36 N., R. 1 W. These are undeveloped.

Bibl: Cal. State Min. Bur. Bull 76, pp. 80–81.

MINERAL SPRINGS.

Big Bend Hot Springs are 65 miles northeast of Redding at Big Bend of Pit River, near Henderson Post Office. Hot water issues at several places for a distance of 350 yards along the south bank of the river. The warmest and largest of the springs has a temperature of 180° and a flow of about 25 gallons a minute. The water is hard, probably containing considerable calcium. The property was equipped as a small resort about 20 years ago.

Bumpass Hot Springs are on the south side of Lassen Peak about one mile northwest of the junction of the Tehama-Plumas and Shasta-Tehama County lines, and about three miles from craters opened during the eruptions in 1914. The hot springs in this region are a phase of the volcanic activity. The surrounding rock is said to have been altered to a white, siliceous material. The waters are in part acid and astringent and sulphur crystallizes around the vents.

Castle Crag Spring (*Lower Soda Spring*) is five miles south of Dunsmuir and a mile east of Sacramento River. The water is strongly alkaline-saline and deposits some iron. The principal constituents are sodium, calcium, magnesium, and high proportions of the carbonate and chloride radicles. A resort is maintained here.

Castle Rock Springs are near Sacramento River five miles west of south of Dunsmuir. The water is similar in general character to that of Castle Crag Spring but not so strongly mineralized. The water has been marketed for many years.

There are other cold carbonated springs on Soda Creek, 1½ miles above Castle Crag Spring, and near the river three-fourths of a mile south of Castle Rock Springs.

The lava beds of eastern and northeastern Shasta County receive a great deal of surface water which later issues as springs. Most interesting of these are the waters of *Burney Creek*, issuing only a short distance above Burney Falls; *Rising River*, 10 miles east of Burney; *Great Springs*, on Hat Creek on the north slope of Lassen Peak, and *Rock Creek Springs* on the western side of Lassen Peak.

Kosk Creek Hot Springs are on the creek of the same name two miles north of Big Bend Hot Springs, and are similar to the latter, though smaller.

Soupan Hot Springs are 2½ miles due west of Bumpass Hot Springs and the waters of the two groups are similar. Some small sulphur deposits occur nearby and have been prospected, but have never been commercially productive.

Bibl: U. S. Geol. Survey, W. S. P. 338, pp. 115, 116, 117, 140, 141, 224–227, 392.

MOLYBDENUM.

Molybdenite, the sulphide of molybdenum, occurs as disseminated flakes in quartz and granitoid rocks. It is soft enough to be scratched by the finger nail and is distinguished from graphite by the color of the streak, which is greenish gray.

In Shasta County it has been found in granite on Hazel Creek, also on Tom Neal Mountain. During the war, a deposit was opened on Boulder Creek near Gibson and a few tons of concentrate were produced by flotation.

Bibl: Cal. State Min. Bur. Bull 91, p. 32: Pre. Rept. 4, p. 23.

PLATINUM GROUP METALS.

Platinum, iridium and osmium have been produced in Shasta County as a by-product of gold dredging on Clear Creek and Cottonwood Creek, and by individual placer miners on Beegum Creek.

The subject was covered in our Bulletin No. 85, 'Platinum and Allied Metals in California.' The Beegum Creek region, and the prospects of platinum found there by the writer, were described in some detail, the conclusion having been reached by him after hand panning that a section of the creek bed would pay to mine. This was substantiated later by a number of miners who worked in the region for a year or so and made at times as much as $20 a day apiece. The section of the stream worked was in the vicinity of Platina P. O. (Noble Station), in the extreme southwest corner of the county. Beegum Creek, a tributary of Cottonwood Creek, here forms the county line between Shasta and Tehama counties. The slate bedrock found here in places along the stream formed an ideal riffle which held the platinum swept down by erosion of serpentine and ancient shore conglomerate forming the surface of the watershed. While the platinum group metals have not yet been traced in California to any deposit in place, field work done for the above mentioned bulletin indicates that these metals came originally from areas of serpentine or basic igneous rocks from which serpentine is derived.

A small production of the metals was made as a by-product of gold dredging on Clear Creek. The Middle Fork of Cottonwood Creek was a more important producer and yielded most of the platinum group metals credited to the county. The principal operator here was Shasta Dredging Company. Platinum production became an important enough factor in the operations of this company to prolong the life of the field two years. Maximum production for the county was 219 ounces in 1921, but since then the above company has finished its ground and production at present is at the rate of only a few ounces annually.

Bibl: Cal. State Min. Bur. Bull. 85, pp. 38, 48–50; also annual statistical bulletins.

SAND, GRAVEL AND CRUSHED ROCK.

Inexhaustible supplies of sand and gravel suitable for use in concrete are available in Sacramento River and its tributaries. Two plants are operating on the river in and near Redding, and one on Clear Creek, one mile west of Girvan. Operation is intermittent.

Crews Plant. Phillip Crews, owner, 17 North Pine Street, Redding. Crews operates a small plant on Sacramento River about two miles east of Redding. River sand and gravel and crushed rock are supplied.

Diestelhorst Plant is on the south bank of Sacramento River within Redding city limits. Owner, Charles Diestelhorst, Redding.

Gravel and sand are dredged from the bed of Sacramento River with a drag-line bucket of $\frac{3}{4}$ cubic yard capacity and carried to the top of the washing and crushing plant. Sand and small gravel are washed and separated and coarse gravel is crushed in primary and reduction crushers. About 50% of the product is sand, which is quite coarse, and for this reason is preferred for highway construction. The plant capacity is 100 to 150 cubic yards a day. Steam is used for power, with crude oil for fuel. It is said to be more economical than electricity because of the irregular and intermittent operations, alternating with periods of idleness, during which latter periods payment for electric power would be required even when not used. A total of 100 h.p. is used.

Oaks Plant is on Clear Creek one mile west of Girvan. Owner, G. E. Oaks, 324 Yuba Street, Redding. Lessees, Savage Brothers, Redding.

Sand and gravel are dug from Clear Creek and elevated to the top of a small crushing and washing plant, where sand and fine gravel are washed and screened and coarser gravel is crushed. Gravel and crushed rock form two-thirds of total production. The capacity of the plant is 150 to 200 cubic yards and operation is seasonal and intermittent, being chiefly in summer and fall. Power is furnished by two Fordson tractors. The product is used largely in highway construction.

SILVER.

Silver Lodes of the South Fork Mining District, Shasta County.[1]

By W. Burling Tucker.

The South Fork Mining District is situated two and a half miles northwest of Igo, and fifteen miles southwest of Redding. The nearest shipping point is Girvan, twelve miles east on the Southern Pacific Railroad.

Topography.

The silver-bearing veins occur in a granitic batholith, which lies between the South Fork of Clear Creek, and Andrews Creek, and is about one and three-quarters miles through the base, along the trend of the main fissure systems, northeast and southwest. The elevations, as indicated by the U. S. Geological Survey, range from 1200 feet to approximately 2300 feet. The South Fork drainage empties into Clear Creek a few miles below the Chicago mine.

---

[1] This section on silver is reprint of an article by W. B. Tucker in our Report XVIII, pp. 313–321, 1922.

History.[1]

Silver ore was first discovered in the South Fork Mining District in 1856. The Chicago mine, the principal producer of the district, was located in May, 1866, by N. S. and J. B. Batcheler. From 1866 to 1881 over $100,000 worth of ore was taken out of this mine. The first shaft sunk on the Chicago mine yielded a handsome profit. The ore from this mine was mostly silver, although some taken from the original shaft ran as high as $200 per ton in gold. Mr. C. N. Kingsbury, an Igo pioneer who worked in the mine in the early 70's, states that the mine was originally worked to a depth of 180 feet, when excessive water stopped operations.

The ore was hauled by wagon to Red Bluff, a distance of about forty miles, shipped by boat to San Francisco, then transhipped by sailing vessel to Swansea, Wales, for reduction. At a later period Mr. Butterfield operated the Chicago mine for a period of four years, and while the metallurgical losses were heavy with the crude practice then available, it is reported that a good profit was made from the mine. During these operations a steam pump was installed and the ore worked in a fifteen-stamp mill, which was located on the South Fork of Clear Creek. Amalgamation was not successful, and concentration was very faulty because of sliming of gray copper sulphides with which the high-grade silver was associated.

In the final operations a depth of 210 feet was reached in the Chicago shaft. Leasers worked the Chicago mine until late in the nineties, but increasing costs of operating at greater depth with crude equipment, and the fall in price of silver finally resulted in the discontinuance of operations. Before this time Mr. William Irelan, Jr., former State Mineralogist of California, became interested in the property. The drifting done on the Chicago lode was evidently considerable, but there is no reliable information as to the actual extent. It was evidently stoped to surface from the stated depth of 210 feet, a distance of about 400 feet southwest of the shaft. According to Mr. Alex Leiter, who was the pioneer Wells Fargo agent at Igo during the entire period that the Chicago mine was an active producer, the output was approximately $1,000,000. In 1900 the present long drainage tunnel on the Silver Falls and Chicago Consolidated group of mines was driven into the mountain 3000 feet. This tunnel was driven by the Igo Development Company, and cost $120,000. The burning of the plant, death of the managing director, and low price of silver caused the company to suspend operations.

Another property in the district worked in the early seventies and eighties was the Big Falls mine, operated by Mr. Ed. Ballou, now known as the Ballou mine. Here the values were mostly gold.

On Andrews Creek, three miles from Igo, is situated the Crystal mine, formerly owned and operated by H. Rothwell, first located in 1866. It is stated that ore shipped from this property ran from $100 to $300 per ton in silver, with low gold values. This property is now known as the White Star Group of mines.

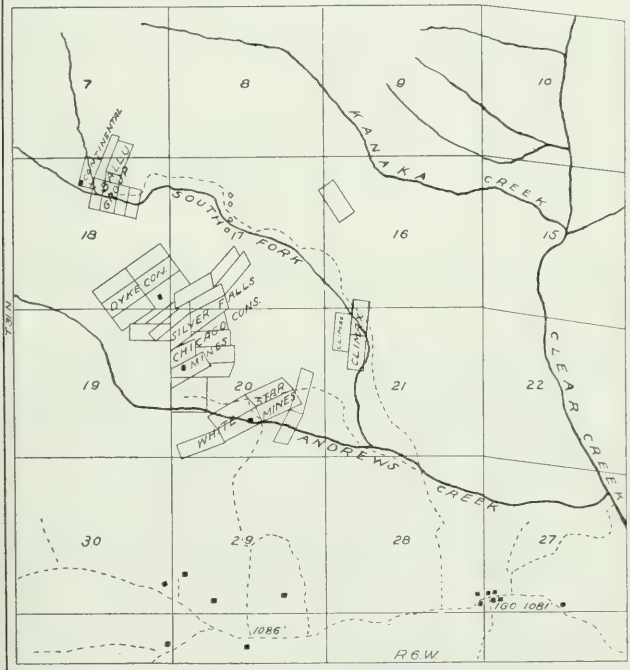
Big Dyke mine, situated north of the Chicago Consolidated mines, was discovered in 1866, and next to the Chicago and Crystal mines was the largest producer in the camp. It is stated that ore shipped from this property ran from $100 to $600 per ton. Acquired by William Dyke and Richter Bros. in 1906. Operated at intervals from 1906 until 1919.

---

[1] M. E. Dittmar, E. M., Crocker Bldg., San Francisco.

Geology.

O. H. Hershey records the formations, in which the fault fissures occur as batholithic in character. He describes the country rock as



SOUTH FORK MINING DISTRICT
SHASTA COUNTY, CAL.

light-gray, medium-textured crystalline, consisting of white feldspar, colorless quartz, dark-green hornblende and dark-brown biotite, and probably a granodiorite. There is a finer-grained phase, possible gneissic inclusions, dark-gray basic segregations and small dikes of pegmatite and aplite. The rock constitutes a fairly large batholith and as the veins all have more or less vertical dips, they may be depended to continue in this granite mass. The veins occupy fissures in the granite. The mountain, according to George Bancroft, is a batholith of quartz-hornblende diorite. J. S. Diller, in Redding Folio, maps the nearby areas of like formation, also as quartz-hornblende diorite and makes note of the batholithic structure.

The granodiorite is traversed by a system of northeast and southwest fissures, roughly parallel. Bancroft recognized two sets of veins, one striking N. 45° E., the other N. 58° E. The dip is generally to southeast at high angles. Near the surface some of these veins show a slight dip to the north, but the average dip is from 75° to 80° southeast. Both walls of the veins have heavy gouge showing some fault movement. The silver-bearing mineral is tetrahedrite, associated with galena, small amounts of pyrite, sphalerite and some chalcopyrite, with small amounts of gold. These roughly parallel quartz veins intersect at small angles, both in strike and dip.

Enrichment has occurred above intersections on the dip, where the convergence points upward. This is illustrated on the map of the Chicago workings, showing different veins and their intersections. The width of the veins varies from 8 to 4 feet. The zone of oxidation is from 10 to 50 feet in depth. Trend of ore shoots is to the northeast.

Water, Timber and Power.

Water and timber are plentiful for mining operations. The Pacific Gas and Electric Company's power line passes within three miles of the district.

Conclusions.

With intelligent development to determine the ore shoots that occur on the intersections of the different vein systems, both on strike and dip, and their general trend, the South Fork Mining District should develop a prominent silver producing area. The principal lack at present is a small flotation plant for treatment of the ores.

Acknowledgments.

The writer wishes to acknowledge the uniform courtesy extended him by owners and operators of mines in the district, and particularly the personal assistance in the field rendered by Dr. F. M. Archer and Chas. Dozier of Redding, and Arch Wright and Albert Kingsbury of Igo.

Big Dyke Mine. It is situated 4 miles northwest of Igo, in Secs. 17, 18, 19 and 20, T. 31 N., R. 6 W., adjoining the Chicago Consolidated Mines Company's property on the north. The property is owned by William Dyke, John and Frank Richter of Igo, California. There are six contiguous lode claims totaling 120 acres; known as the Big Dyke Group.

Claims: Edna, Little Dyke, Alta, Helen, Dyke Extension and Big Dyke.

Development has been confined to the Big Dyke vein on the Big Dyke claim.

A series of roughly parallel veins in the granodiorite, strike N. 60° E., and dip slightly to the southeast from the vertical. The Big Dyke fissure is about 3 feet in width with a filling of quartz and altered granite having heavy gouge on both walls. This filling is heavily mineralized with argentiferous galena, tetrahedrite, some pyrite, sphalerite, some native silver and a small amount of gold. The veins are oxidized and leached to a depth of 20 to 50 feet.

Developments: At an elevation of 2000 feet a vertical shaft was sunk to a depth of 153 feet on the vein. On the 100-foot level the vein was drifted on 165 feet to the northeast, and 20 feet to the southwest. Some stoping was done on the ore shoot on this level, and a shipment made to the Mammoth Smelter at Kennett is said to have averaged 300 ozs. of silver per ton. About 50 feet below this level a drift was run 65 feet northeast on the vein. About 100 feet below the collar of the shaft there is a crosscut tunnel 200 feet long which intersects the vein on the 100-foot level, 100 feet northeast of the shaft. Southwest of the shaft a tunnel, now caved, was driven 200 feet on the vein. It is reported that the ore in the shaft has a width of 12 to 36 inches; assays range from $20 to $400 per ton.

Equipment: 15-h.p. gasoline hoist, 20-h.p. air compressor and pumps. Idle.

Climax Mine is situated three miles northwest of Igo, on the South Fork of Clear Creek, in Secs. 16 and 21, T. 31 N., R. 6 W., elevation 1200 feet.

Holdings consist of three claims, known as Climax, South Climax, and West Climax, totaling 60 acres. The occurrence of the veins on the Climax group of mines is somewhat different than the main northeast and southwest fissures that occur in the granite batholith in the South Fork mining district, as the principal vein developed on the Climax group of claims occurs on the contact of the granite and meta-andesite. The granite is the footwall and meta-andesite the hanging wall of the vein. The general strike of the contact is N. 10° E., dip 50° east. No prospecting or development work has been attempted to date to determine the possibility of finding ore on the intersection of the northeast and southwest veins with the contact and this point is worthy of investigation. The vein which occurs on the contact is a black carbonized slate cut by numerous stringers of quartz, and in places this carbonized vein material is replaced by quartz.

The enclosed vein material is mineralized with pyrite, chalcopyrite, small amounts of galena, and some sphalerite. About eighty feet west of the contact, a vein of quartz occurs in the granite, having the same general strike and dip as the vein on the contact. Two hundred feet west of the Climax shaft is another system of quartz veins in the granite. One strikes N. 40° E., and dips 80° east, the other strikes N. 20° E. and dips 70° east. Average width of veins is 4 feet.

These two veins intersect the contact north of the Climax shaft. The vein quartz shows the presence of silver chlorides and some galena. On the Climax claim, a shaft has been sunk to depth of 150 feet on a vein in the granite running parallel to the main contact vein. On the 100-foot level, a drift has been driven south 50 feet and north 40 feet on the vein, developing a lenticular shoot of ore fifty feet in length, width of ore being from 12 inches to 2 feet. The vein pinched below this level, and the shaft was sunk in the granite footwall to the 150-foot level. On this level a crosscut has been driven east 75 feet cutting the contact vein which has a width of 10 feet.

Vein material is black carbonized slate, containing numerous stringers of quartz. South of the Climax shaft about 150 feet, there is an incline shaft, 75 feet deep on the contact vein, which has been stoped to the surface north and south of this shaft for a distance of 100 feet.

The Black Prince shaft is 150 feet south of these workings, and was sunk to a vertical depth of 110 feet. The shaft started on the contact vein, but a short distance below the collar cut through the vein and passed into the granite footwall.

On the 100-foot level a crosscut was driven east to the vein on the contact, where it is reported to have a width of 10 to 20 feet. The average value of the ore extracted from this vein is reported to have been $10 per ton in gold and silver.

On the South Climax claim there is a shaft 33 feet deep, which cut the vein on the contact. The vein quartz carries native silver, tetrahedrite, sphalerite, chalcopyrite, pyrite, and some gold mostly associated with the pyrite. A shipment of ore from the Climax shaft was made to the Selby Smelter in 1922, amounting to 4210 pounds, which assayed 0.08 ounces gold, 214.9 ounces silver, 6.6 per cent lead, and 25.2 per cent zinc.

Mine equipment consists of 9-h.p. gasoline hoist, 6″x4½″ Gardner compressor, driven by 15-h.p. Fairbanks-Morse gas engine, blacksmith shop, air drills, and assay office.

Two men are employed. Owner: W. W. Robinson of Redding; Louis Davidson, superintendent.

Continental Mine. It is 6 miles northwest of Igo, on the South Fork of Clear Creek, at an elevation of 2200 feet. Holdings consist of 7 claims, in Secs. 7 and 18, T. 31 N., R. 6 W., and adjoin the Ballou Group of claims, on the west. There are two veins on this property, one which strikes N. 10° E., the other striking N. 45° E., and dipping 80° SE. Country rock is granodiorite. On the slope of the ridge north of the South Fork of Clear Creek, a crosscut tunnel has been driven N. 50° W., intersecting the vein, which has a course of N. 45° E. The vein has been drifted on 200 feet northeast. This vein is 8 inches to 3 feet wide and the fissure is filled with quartz and altered granodiorite, with gouge on both walls. The fissure is heavily mineralized with argentiferous galena, pyrite, tetrahedrite, sphalterite, and native silver, and carries a small amount of gold. The vein is oxidized and leached to a depth of 20 to 50 feet. This tunnel gives a depth of 200 feet vertically below the outcrop. Near the top of the ridge, about fifty feet below the outcrop, a tunnel was driven on the vein, extent not known and now caved, but probably 200 feet. At the mouth of the tunnel there is a shaft. On the surface the outcrop of quartz is 8 to 10 feet wide and can be traced for at least 3000 feet. In the eighties the operators had a 6-stamp mill on the South Fork, where ore was milled from these upper workings. Equipment consists of cars, track and blacksmith shop. Property idle. Only assessment work done. Owners: V. V. Apperson and associates of Willows, California.

Manzanita Mine. (Ballou Group of Mines.) This group of mines is situated 6 miles northwest of Igo, in Secs. 7 and 18, T. 31 N., R. 6 W. The workings are on the north slope of the ridge, northeast of the South Fork of Clear Creek, at an elevation of 2300 feet. Holdings consist of 5 claims, namely: Hope, Sulphide, Manzanita, Greater Falls Series, Plus Series, all held under U. S. mineral patents, totaling 100 acres. The property is owned by May V. Ballou of Redding, California. These claims were located December 13, 1880. A series of parallel quartz veins, whose general strike is N. 20° E., and dip 80° E., traverse the granodiorite. On the Manzanita claim, at an elevation of 2300 feet, a crosscut tunnel was driven 30 feet west, cutting a vein which strikes N. 20° E. This vein was drifted on to the south 200 feet. The vein has a width of 8 inches to 2 feet, but the pay ore occurs in a seam of oxidized quartz near the footwall that is heavily stained with iron. This seam carried high gold values. The quartz carries gold, and some pyrite. This tunnel is only about 75 feet below the surface and in the oxidized zone and probably with greater depth one may expect to encounter silver-bearing ores, as in the rest of the district.

There are seven tunnels and one shaft on the property. Tunnel on the Hope claim is 700 feet long. On the Sulphide claim there is a tunnel 300 feet in length, besides a number of shorter tunnels, from 50 to 100 feet in length.

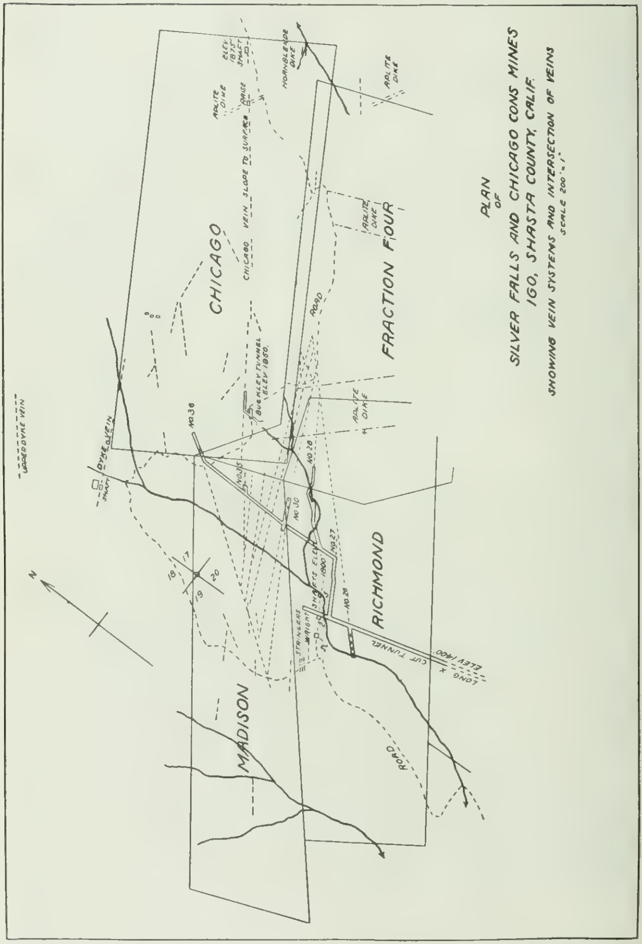
George Z. Bertchy of Oakland was preparing March, 1926, to begin work on the claims. A small mill was being hauled to the property.

The Silver Falls-Chicago Consolidated Mines group has been the most important mine in the district. It is 4 miles northwest of Igo. The present works are in Secs. 17, 18, 19, 20, T. 31 N., R. 7 W., on the southwestern slope of the mountain, at an elevation of 1400 feet. The property is owned by Mrs. Clara Archer of Redding, California. Holdings consist of the following claims: Pillchunck, Union Cold Spring, Richmond, Madison, and Chicago, held under U. S. mineral patents; Fraction No. 1, Fraction No. 2, Fraction No. 4, Metal, Amy and Batholith, by location, totaling 220 acres.

Developments consist of the main Chacigo shaft which was sunk to a depth of 210 feet on the Chicago-Madison vein, and stoped to the surface 400 feet southwest of the shaft. Production from these workings was approximately $1,000,000.

On the Richmond claim, 3 shafts, known as the Wright shafts, were sunk on the Richmond lode system. No. 1 shaft is 30 feet deep; 40 feet northeast of this shaft is No. 2 shaft which was sunk to a depth of 80 feet; and 60 feet northeast of the latter is No. 3, having a depth of 20 feet. A drift was driven from No. 1 shaft to No. 2. The vein in these workings is said to be from 10 inches to 2 feet wide. When work was suspended in No. 2 it is reported that there was 12 to 18 inches of good ore in the bottom. Ore mined from these workings was sorted up to 400 ozs. silver per ton and shipped. Samples taken from ore in place along the strike of the vein between these shafts ran from 10 ozs. to 163 ozs. in silver per ton. The ore shoot is 120 feet long, average width 12 inches. These shafts are approximately 2150 feet north of the portal of the main crosscut tunnel, the surface being 540 feet above the tunnel level.

At the southwest end of the Chicago claim a crosscut tunnel was driven 50 feet, cutting the main Chicago-Madison vein, and a drift run northeast 75 feet and stoped out to the surface. The vein is 12 inches to 2 feet wide, carries high values in gold, and samples taken from the



PLAN
OF
SILVER FALLS AND CHICAGO CONS MINES
IGO, SHASTA COUNTY, CALIF.
SHOWING VEIN SYSTEMS AND INTERSECTION OF VEINS
SCALE 200' = 1"

face of the drift ran $26 per ton in gold. These workings are 550 feet above the tunnel level. In 1900 a crosscut tunnel was driven 3000 feet in the mountain, at an elevation of 1400 feet, giving a depth of 600 feet below the outcrop of the Chicago vein. This tunnel cut 36 fissure veins as identified and mapped by George Bancroft. Quite a number of these veins are little more than seams or fractures in the granite. The most prominent may be classified as the Pillchunck, Union, Cold Spring, Richmond and Chicago-Madison lode systems. The Pillchunck, cut in the tunnel at a depth below the surface of 261 feet, was the first vein of any consequence. A drift was driven on this vein about 100 feet northeast, but not driven far enough to cut the ore shoot developed on the surface. The vein shows some quartz with heavy gouge on both walls. Further in the mountain the Union vein system was cut 384 feet below the surface. The next exposure of importance is on veins 26 and 27. The crosscut here obtains a depth of 540 feet vertically below the surface and then extends northeasterly 200 feet as a drift on 27. The tunnel then turns due north and is continued as a crosscut 600 feet farther to what is known as vein No. 36, which was drifted on 100 feet.

Vein No. 28, which was cut in this crosscut, was drifted on northeast 225 feet. In this drift a shoot of ore was developed having a length of 210 feet, the vein averaging 12 inches in width. Ore stoped about 20 feet above drift. Shipment made from this stope in February, 1910, to the Mammoth Smelter, without sorting, assayed 17.7 ozs. ag. and $0.83 in gold. Shipment included all vein matter between walls in the five-foot fissure. Veins No. 30 and No. 35 were drifted on only a short distance. No. 35 is evidently the main Chicago-Madison lode, although it may be vein No. 30. This system apparently includes veins 28 and 30 intersecting on the northeasterly strike. Vein No. 30 intersects veins 35 and 36 several hundred feet from the tunnel on the southwesterly strike. The intersection of the veins on both strike and dip is important in forming ore shoots. Ore shoots form in lenticular masses of quartz, varying in width from 10 inches to 4 feet.

In October, 1922, California Bi-Metallic Corporation of Santa Barbara began active development of the property under lease and option to purchase. They employed a crew of 25 men and installed some equipment. They did over 1400 feet of new development.

In the main tunnel 500 feet from the portal, they drifted on the Pillchunck vein over 270 feet northeast and 50 feet southwest. The vein in southwest drift was said to assay well and to show three feet of mineralized quartz. A raise was also put up on No. 28 vein at the intersection of crosscut No. 36, and the drift on this vein was extended several hundred feet northeast. At about 380 feet from the raise a rich shoot is said to have been found, showing from eight inches to two feet of quartz, that assayed high in silver and gold. The main crosscut was extended 190 feet to vein 36. A crosscut was run south from No. 27 drift 30 feet to vein 26, which was drifted on northeast for 120 feet.

In the Buckley tunnel on the main Chicago-Madison lode, 40 feet was drifted and other work was started. The company has since quit work and the property is idle.

Equipment includes a 12″ by 12″ compressor, 50 h.p. gas engine, blower, 10 h.p. gas engine, drill sharpener, 6 air drills and 12 ore cars.

There are two bunk houses, assay office, compressor house, shop, office and residence.

Bibl: Cal. State Min. Bur. R. XVIII, pp. 316–318; R. XIX. p. 13.

White Star Silver Group of Mines (formerly known as Crystal Mine). It is situated three miles northwest of Igo, on Andrews Creek, at an elevation of 1250 feet. The property is owned by Thomas Kingsbury, Albert Kingsbury and J. D. Hubbard of Igo, California. Holdings consist of the following claims: J. D., White Star, North Star, Wood, Contact, Contact Fraction, Henry Ford and Henry Ford Extension, totalling 160 acres. These claims are located in Sec. 20, T. 31 N., R. 6 W.

Three parallel veins cut the granodiorite, and are about 20 to 40 feet apart. Strike northeast, dip 80° southeast. The ore carries native silver, tehrahedrite, sphalerate, small amount of pyrite, chalcopyrite, and some gold associated mostly with the pyrite.

Developments: Outside of a number of prospect shafts and short tunnels, all work has been confined to the middle vein. A crosscut tunnel has been driven N. 50° W., 320 feet, which cut the three veins at a depth of 90 feet below the surface. No. 1 vein was cut 150 feet from the portal of the tunnel, and drift run 50 feet to the northeast and 35 feet to the southwest, and was stoped about 15 feet above the drifts. Vein has a width of 12 inches to 3 feet. Twenty feet farther on it cut No. 2 vein, which was drifted on 100 feet to the southwest, and 60 feet to the northeast. On this level, 20 feet to the southwest, a raise was run to the surface on ore. The ore extracted from this raise is said to have carried high gold values, and it was stoped to the surface. In the northeast drift on this vein, at a distance of 40 feet from the crosscut tunnel, a raise was made for 40 feet, then the vein was drifted on 40 feet to the southwest and connected with the shaft from the surface. The main crosscut tunnel continues 160 feet, where it cut No. 3 vein, which has a width of 2 feet, but no development has been done on this vein. At 10 feet northeast of the main crosscut tunnel, a winze has been sunk 50 feet and a drift driven on the vein 100 feet northeast. No. 1 and No. 2 veins intersect northeast of the winze on this level forming an ore shoot 60 feet in length. Width of the vein is from 2 to 5 feet.

A shipment of ore made from this shoot to the Selby Smelter on April 27, 1922, ran 150 ozs. in silver, 0.2 oz. gold, 1.8% lead, and 13.3% zinc.

The property has been operated off and on by Mr. Albert Kingsbury, who has shipped about $2,000 worth of ore to smelters. The general run of ore from this mine will average from $10 to $50 per ton.

Equipment: Consists of cars, handpump, blacksmith shop and tools. Development work in progress.

TALC.

At the property of Ganim Gold Mines Company in Secs. 5, 8, and 15, T. 32 N., R. 6 W., 2½ miles northwest of Whiskeytown, a deposit of good grade white-grinding talc has lately been developed. Redding, the nearest railroad point, is 13 miles east by good road.

An adit 900 feet long, starting in an easterly direction, cuts the talc about 600 feet from the portal, and shows talc for a distance of about 50 feet. The body of talc is cut diagonally by the adit, both on the dip and strike, as the talc strikes N. 30° W. and dips about 45° SE. About 425 feet from the portal a drift runs north to northwest on a curving course, cutting the talc and being about on its strike for 50 feet at time of visit, March 17th. These openings show the presence of good-grade talc at points about 100 feet apart on the strike. At the northwest face the backs are about 100 feet, and good-grade talc has been found at the surface. Presuming the talc to be continuous on the dip to the surface, and on the strike between the points cut (although this has not been positively proved by raises or crosscuts) the amount is large.

The talc is of apparently uniform quality, free from grit and dark colored impurities where opened at time of visit. Reported analyses are as follows:

SiO_2	60.75	61.90
Fe_2O_3	0.88	0.65
Al_2O_3	2.28	0.87
Lime	----	----
MgO	30.40	30.34
Ignition loss	5.73	----
Titania	----	----
Moisture	----	0.26
Combined water	----	4.90
Alkalies by difference	----	0.90
Mn_3O_4	----	0.18

Several carloads have been shipped during 1926.

L. R. Lehman, 811 South St., Redding, has submitted samples of talc to the Bureau from an undeveloped prospect 12 miles southwest of Redding, on the west side of Clear Creek. The samples contained a little iron oxide.

ZINC.

In the past few years zinc has become the principal product of the mines at Bully Hill and Ingot. Other mines in the copper belt, now idle, contain zinc sulphide associated with the copper ores, but are not known to carry such a high percentage of zinc as the Afterthought or Bully Hill mines. Electrolytic zinc was produced during the war both at the Mammoth plant at Kennett and at Winthrop. Much zinc has been lost in the past as the copper smelters were not equipped to save it. The flue dust saved in later years at the Kennett smelter, and remaining unworked up to the present time, contains a good deal of zinc, as well as other metals. Plans are now under way to treat this flue dust in a plant just erected at the smelter site, as mentioned farther on. Some zinc ore was shipped years ago from the Donkey Mine near Ingot. Lately some small prospects carrying zinc have been noted farther northeast of Ingot near the road to Montgomery Creek. These are not active.

Afterthought Mine. Operated by California Zinc Company. Main office, Winthrop, California. The property contains 1650 acres in Secs. 5, 10, 11, and 25, T. 33 N., R. 2 W., near Ingot, 24 to 25 miles northeast of Redding. J. F. Dugan, General Manager. R. W. Adams, Superintendent.

The activities of Afterthought Copper Company terminated late in 1923 with the sale of the property under foreclosure to the Milliken interests. The California Zinc Company began work in February, 1925. The 300-ton flotation plant and the reverberatory furnace which were erected in 1918 by the former company and the entire reduction works at Ingot have been abandoned, partly dismantled and much of the machinery removed to Bully Hill or Winthrop.

A new aerial tram, 8½ miles long has been built from the Afterthought to the company's plant at Winthrop. This tram carries 80 buckets of 850 pounds capacity each, at a speed of six miles per hour, so has a capacity of 288 tons per 24 hours. The longest span is 4700 feet. This tramway was put in operation in November, 1925, and at present is delivering about 75 tons a day to the flotation plant at Winthrop.

Surface plant and tram terminal, Afterthought mine, near Ingot.

No increased depth has been reached, the bottom of the main shaft remaining at 800 feet, vertically. A new shaft has been raised from seventh to fourth level. Ore is being mined on several levels.

The ore occurs in shear zones in rhyolite near the contact of shale. Two roughly lens-shaped orebodies, called the Afterthought and Copper Hill lodes, strike northwest and dip 70° NE. During 1923 it was estimated that some 300,000 tons of ore were developed, carrying an average of 16% zinc, 3% copper, 5½ ounces silver and 0.03 ounces gold per ton. The ore now being mined is stated to run about 18% zinc and 2½% copper. It is finely disseminated, carrying sphalerite, pyrite, chalcopyrite, galena and bornite.

The profitable operation of the Afterthought has always been a difficult problem because of the complex nature of the ore. The sphalerite in the ore is a primary constituent of it, according to

Diller.* The attempts of the Afterthought Copper Company to produce separate zinc and copper concentrates by collective and selective flotation were not successful, as the two metals could not be cleanly separated. The "copper concentrate" carried 12% zinc and zinc "concentrate" 2.6% copper, so that a clean zinc product was not obtained for the furnace. The present treatment consists of making a bulk concentrate, dropping as much pyrite as possible, as described under Bully Hill Mine. Forty men are employed at the Afterthought.

Bully Hill Mine. Operated by California Zinc Company. Main Office, Winthrop, California. J. F. Dugan, general manager. The property is at and near Winthrop in Secs. 12, 16, 21 and 28, T. 34 N., R. 3 W., and is connected with S. P. Co's. main line by Sacramento Valley and Eastern Railway, extending from Pit to Winthrop.

The eastern lode in the Bully Hill Mine and the Western Lode in the Rising Star (under the same ownership) are almost parallel and about 200 yards apart. They strike about N. 10° E. and dip nearly vertically and the ore shoots pitch steeply north. The ore is in lenses in shear zones in the rhyolite. A recent development, reported by the present operators, is the finding of small, hitherto unmentioned orebodies in a body of gypsum on the footwall side of the shear zone in the Rising Star Mine. This gypsum formation is about 200 feet wide and 700 feet long and extends up as far as the 700 level. All operations underground are confined to the Rising Star Mine, which is developed by adits, a shaft 1100 feet deep, and levels 100 feet apart. The shaft is sunk from the main adit level (No. 5) and work below here is being done on the 6th, 7th, 8th, 9th, and 10th levels. The present company has done no new shaft sinking but has opened the downward extension of the 900-level orebody. During the war this property as well as others in the county was worked with the idea of getting out the most copper in the shortest possible time and the Rising Star Mine is credited with a production of 27,000 tons of 6% copper ore in 1918. The zinc orebodies now being mined are the shells left from past operations, in large part. The orebodies vary in size from a few inches wide up to lenses as much as 30 feet wide and 100 feet long. The average ore carries 20 to 22% zinc, 1½ to 2% copper, 2 ounces silver and 60 cents gold per ton. The principal ore minerals contained are pyrite, chalcopyrite, sphalerite, and small quantities of galena, chalcocite and bornite. Barite and quartz are the principal gangue minerals.

Ore Treatment.

The later history of operations at Winthrop is like that at Ingot. A plant for the production of electrolytic zinc by electrolysis of zinc sulphate was operated by General Electric Company in 1915, and made some production. In 1917, Bully Hill Mining Company took the property and in addition to shipping selected copper ore, built a 150-ton flotation plant, which was not a success. In 1920, Daniel C. Jackling and others organized Shasta Zinc and Copper Company and began operations. During the few years preceding, a great deal of development work had been done in the Rising Star Mine and it was estimated that 300,000 tons of ore had been blocked out. The new company proceeded to construct a reverberatory furnace and a zinc oxide plant, which was put in operation in June, 1922, and operated until December, 1922, when it was closed down, ostensibly because of the drop in the price of zinc oxide. The method of treatment consisted of preliminary roasting of fine ore mixed with coal dust and fluxes, in McDougall roasters, then smelting it in a reverberatory furnace, where copper matte was produced; gases containing zinc oxide (produced when the zinc sulphide ore was reduced, and volatilized zinc was re-oxidized) were passed through a series of large bags, where crude zinc oxide was recovered. This was treated in a refining furnace, and zinc oxide recovered a second time in another bag house. The plant had a capacity of 30 tons of zinc oxide and 20 tons of copper matte a day.

---

* Diller, J. S., Redding Folio No. 138, U. S. Geological Survey.

General view of plant of California Zinc Company at Winthrop, showing tram terminal and ore bins on left, concentrator and smelter.

Late in 1924, California Zinc Company took the property. They have abandoned the system of treatment described above and are at present employing oil flotation. The present product is a bulk concentrate containing zinc, copper, lead, gold and silver, which is shipped to Belgium for treatment. Experimental work is carried on, and some scheme of selective flotation may later be used. The system in use late in April, 1926, is outlined below, but a complete flow sheet is not shown as the operators state that minor changes are frequent.

About 75 tons of ore from the Afterthought aerial tram and 130 tons from the surface tram from Bully Hill are delivered daily to the coarse-ore bins. This contains an average of 16% to 22% zinc, 9% to 10% iron and 1.8% to 2.08% copper as well as a little galena, gold and silver. It is sent by belt conveyor to a gyratory crusher and to Garfield rolls, is screened to one-half inch on a vibrating screen, and fine ore is conveyed to fine-ore bins. It is fed from here to a belt conveyor by belt feed, and delivered to two Marcy mills in closed circuit with Dorr classifiers. A 20% solution of copper sulphate is added at the head of the Dorr classifier overflow. Fine pulp goes to a steady-head tank and to a 16-cell Minerals Separation flotation machine. The froth product from first six cells is treated in a recleaner; froth from next four cells is returned to the head of the machine and from last six cells to cell No. 10. Reagents used are 0.15 lb. potassium xanthate, small quantities of 634 Barrett oil, water-gas tar and pine oil, as well as 6½ lb. of lime per ton of ore. The lime alkalizes the pulp and makes it possible to drop about one-half of the pyrite.

The tailings from No. 1 flotation machine pass to a second set of 22 flotation cells. The froth (concentrate) from the first 9 or 10 of these cells is cleaned in two primary cleaners in series, and the froth from these goes to a recleaner, from which the finished product is taken. This is thickened in a Dorr thickener, filtered through an Oliver filter and taken by belt conveyor to railroad cars for shipment, or to bins. Tailings from the primary cleaners are returned to the head of No. 1 flotation machine, tailings from the recleaner to head of the primary cleaner, and tailings from end cells of No. 2 flotation machine go to waste, froth having been returned to head of machine.

Concentrating plant of California Zinc Company at Winthrop.

The recovery is stated to be 90% to 96% of zinc, 85% to 86% of copper and 70% of silver. Concentrates contain 43% to 49% zinc, 3.7% to 4.1% copper, 7% to 11% iron, 1.3% to 1.7% lead and 2.3% silica, so that the concentration of valuable metals is a little better than 2:1.

About 100 men are employed at the Bully Hill Mine and at Winthrop.

Old Glory Group of five claims is 5½ miles northeast of Ingot on the opposite side of the highway from the St. John prospect. Owners, B. F. Bibbens and H. C. Woodrum, Redding.

The rock is grey limestone, in which occur seams striking northwest which carry galena, and another system of seams striking nearer north carry zincblende. The Old Glory claim is said to show a fair prospect of zincblende, while on the Highway Claim a vein three feet wide at a depth of 10 feet is reported to assay well in lead at points 300 feet apart. Only assessment work has been done by the present owners, including the reopening of an old adit 200 feet long on Highway claim.

Pacific Mineral Corporation. F. M. Ball, 112 Market Street, San Francisco and Fred Grotefend, Kennett, have lately installed a 60-ton plant at Kennett for testing the Elliott Process upon the accumulation of flue dust at the Mammoth smelter. The plant had not been completed at the time of visit, but a trial run has since been made and is reported successful. The process is one patented by Alexander Elliott and while full details have not been given out, it is a wet chemical treatment, using lime, sulphur and iron. The plant consists essentially of an ore bin, 20-ton Pachuca tank, several large redwood tanks divided into 11 separate compartments, and a small furnace for calcining. The first step is the removal of copper by solution with acid, which is provided by sulphide ore or concentrate, which also provides the iron. It is claimed that removal of copper is so complete that it is possible to produce next a very high-grade zinc oxide, which is pure white after calcining. Grotefend claims that the time for treatment is only three hours, and that two-per-cent copper ore can be profitably worked. The cost per pound of copper would be only a fraction of that by other methods.

There is estimated to be about 20,000 tons of flue dust at Kennett, which contains copper, zinc, gold, silver, lead, antimony, cadmium and sulphur. The owners had previously tried many methods for working this, but without success, although it is said to be worth considerably over $20 a ton. Should the Elliott Process prove commercially applicable, its importance to Shasta County will be much farther reaching than the mere recovery of the above locked-up metals, as there are large tonnages of low-grade copper and copper-zinc ores available, which are too low grade to smelt, but could be made to yield a profit by a cheaper process. The location of the new plant on the railroad in the heart of the copper mining district is advantageous, and the preliminary tests are being watched with great interest locally.

St. John Prospect is 5½ miles northeast of Ingot by road, in SE¼ of SE¼ of Sec. 30, T. 34 N., R. 1 W. Mrs. C. E. Eilers, Ingot, is the owner and claim is leased to E. Cartwright of Ingot.

An orebody 8 feet by 60 feet outcrops on the claim just east of the state highway. It has been prospected on the surface. The ore is mostly brown zincblende, with a little galena and copper sulphides. The ore appears as an irregular mass and stringers in grey limestone, and picked samples yielded 19% zinc. A few tons have been hauled away and milled by Cartwright. The Washington claim across the road shows a lead prospect. No work was being done in April, 1926.

SAN FRANCISCO FIELD DIVISION.

C. McK. LAIZURE, Mining Engineer.

SAN BENITO COUNTY.

Introduction.

On February 12, 1874, that portion of Monterey County lying north and east of the Gabilan Mountains was separately organized as San Benito County.[1] The eastern boundary of this new county was originally an irregular line following the summit of the Diablo Range, which had likewise served as the former boundary of Monterey County since 1850. The area of San Benito County, however, was increased considerably in 1887 by changing the irregular eastern boundary along the summit of the Coast Range to straight lines based on the United States surveys which took in portions of western Fresno and Merced counties. With this change in 1887 its area and outline became practically the same as they are today.

Geography.

San Benito is one of the central counties situated between Monterey, a coast county, which adjoins it on the south and west and Merced and Fresno, two of the great San Joaquin Valley counties, which bound it on the northeast. Santa Clara County and a corner of Santa Cruz adjoin on the north.

The county extends southeasterly from Pajaro River for 70 miles with an average width of 20 miles. Its area is 1392 square miles and the population, most of whom reside in or near the few towns along the railroad in the northern part, is 8995 (1920 census).

About one-fourth of the county is government land. Most of the remainder was long held in the form of large land grants and immense ranchos. As may be expected, cattle-raising early became an important industry and it still is of prime importance. In later years some of these ranchos have evolved into fruit orchards and small farms due to irrigation and intensive cultivation of the valley lands. As a result, fruits and vegetables, dairy and poultry products, as well as hay, grain, and live stock have become important sources of wealth. Mining has been carried on since 1858, the total recorded mineral production to date approximating $30,000,000.

Transportation facilities are limited. There is a branch of the Southern Pacific railroad from Gilroy, via Hollister, the county seat, to Tres Pinos. The main coast line of the Southern Pacific also touches the county at Logan, after passing through Pajaro Gap. The 'California Central,' a line 8 miles in length connects Old Mission Portland Cement Company's plant with the Southern Pacific at Chittenden. Other parts of the county are served by auto stages from Hollister and Tres Pinos. The southern section can be reached equally as well through Coalinga or Mendota on the San Joaquin Valley side or from King City and San Lucas on the west. Excellent highways join Hollister with Merced on the valley highway route and with San Juan Bautista on the coast route of the state highway system. The road to the interior is by way of Pacheco Pass.

Topography.

The famous Santa Clara Valley penetrates the northern end of the county as far as Hollister. From this point the narrow valley of San

---

[1] Coy, Owen C., California County Boundaries, California Historical Survey Commission, Berkeley, 1923.

Benito River continues southeasterly to the southern boundary. This river and its chief tributary, Tres Pinos Creek, with many smaller streams flowing in from east and west practically drain the entire area. Numerous smaller mountain valleys are found along the flanks of the two ranges of the Coast system, which roughly parallel one another and dominate the topography. The mountains on the western side are known as the Gabilan Range, the peaks of which range from 3000 to 3500 feet in elevation. The Diablo Range on the east rises in many of its peaks to elevations of nearly 5000 feet. In the southeastern corner of the county, east of the summit of the latter range, Panoche and Silver creeks drain a small area which is a portion of the San Joaquin watershed.

Geology.

There is considerable literature on the geology of portions of San Benito County but most of the detailed geologic studies have been confined to those sections considered to be possible oil-bearing territory or to the quicksilver mining districts, and no single geologic report fully covers the county. The reader who is primarily interested in the geology should refer to the publications listed in the bibliography.

The general geology as shown on the geologic map of California published by the State Mining Bureau in 1916 is briefly outlined in the following paragraphs.

The Gabilan Range on the western side is composed of ancient granitic rocks associated with crystalline schists and limestones. Dolomite and more rarely barite deposits occur with the limestone and have been developed from San Juan Bautista southerly to Cienega Valley. Farther south in a small area surrounding the Pinnacles National Monument which in itself is an example of intense vulcanism, fine-grained volcanic rocks occur. In the southwestern portion of the county from Topo Valley south and east to San Benito River the formations exposed are sedimentary rocks of Tertiary age which include numerous gypsum beds, some bituminous sandstones and diatomaceous earth.

On the northeastern side of the river the Diablo Range rises abruptly and from near Hernandez south and east beyond San Carlos Peak it is made up of Franciscan rocks chiefly serpentine but with much red chert, sandstone, slate and schist near the river. From Idria northwesterly nearly to Llanada, Cretaceous and Tertiary rocks make up the main range. From Llanada northward to the northern end of the county the Diablo Range is typical of the Coast Mountains, consisting of serpentine, chert, metamorphic sandstone, slate and schist. Quaternary and late Tertiary sediments comprise the valley area surrounding Hollister and sandstone, shales, sands, gravels and clays are much in evidence along San Benito River as far south as Hernandez.

San Andreas fault, a dominant structural feature of the geology, enters the county near Chittenden and runs southeasterly along San Benito River as far as the town of San Benito. From here it crosses a low divide into Rabbit Valley and from there it follows Bitterwater Creek to its junction with Lewis Creek and then continues southward up Lewis Creek.

Mineral Resources.

An extensive and diversified number of mineral substances are found in San Benito County. Both metallic and nonmetallic minerals are included in its resources, but commercial production has been limited, and many deposits have remained entirely undeveloped on account of their distance from railroad transportation. Neglect of mining opportunities may also be due in part to the fact that many deposits are on private lands whose owners are interested in other lines of activity.

Quicksilver production has given San Benito its reputation in the mining world, as it ranks among the oldest and most important quicksilver producing counties. The New Idria mine, in the southern part, is the largest single producer of quicksilver in the state. Since 1918, however, the value of the county's annual output of quicksilver has been exceeded by that of cement. Crushed rock production closely follows quicksilver in annual value of output. Other mineral products which have been produced in greater or lesser amounts are: antimony, asbestos, asphalt, bituminous rock, brick, chromite, coal, dolomite, gems, gypsum, lime, and limestone, magnesite, manganese, and mineral water.

Barite, clay, copper, diatomaceous earth, feldspar, gold, iron, montmorillonite, petroleum, strontium and volcanic ash also occur here but the commercial value of these deposits is not as yet established. A number of other mineral species are represented in the county but their occurrence is of mineralogical interest only.

The last full report on San Benito County was published in State Mineralogist's Report XV, 1915–16. Some additional notes were contained in the monthly chapter of Report XVIII, MINING IN CALIFORNIA, May, 1922. In 1918, Bulletin No. 78, 'Quicksilver Resources of California,' was issued. This bulletin covered all quicksilver districts in the state and contains a detailed description of the mines and reduction plants in San Benito County. The occurrences of chromite and manganese are discussed in Bulletin No. 76, 1918. Bulletin No. 79, 'Magnesite in California,' 1925. includes descriptions of the magnesite mines in this area. The possibilities of oil production and the geology of much of the county are covered in detail in Bulletin No. 69, 'Petroleum Industry of California,' 1914, (out of print) and in Bulletin No. 89, 'Petroleum Resources of California,' 1921 (out of print). Earlier reports and bulletins describe many other occurences of minerals of possible economic value.

In order that these notes might conform to the new series of county reports begun in State Mineralogist's Report XXI, MINING IN CALIFORNIA, January, 1925, and continued in quarterly chapters thereafter, the county was visited in March, 1926, for the purpose of bringing all available data up to date. While an endeavor has been made to make this report as complete as practical, due to the short time allotted for field work, detailed descriptions of the mines and properties have been omitted, in cases where they have been sufficiently covered in former reports.

The writer wishes to acknowledge the uniform courtesy of mine operators and owners of mineral deposits, and particularly the personal assistance rendered by Mr. H. V. Underwood, Sunnyvale Road, Hollister. Mr. Underwood has been active in prospecting many deposits, particularly of the nonmetallic minerals, and he is exceptionally well acquainted with the county's undeveloped mineral resources.

San Benito is a county which might easily be overlooked in naming the 'mining counties' of the state, yet its mineral output in 1924 was valued at over two million dollars, and it ranked nineteenth among the fifty-eight counties of the state. The following table gives the total recorded production, which covers the period from 1865 to 1924, inclusive.

Year	Quicksilver		Lime		Gypsum	
	Flasks	Value	Barrels	Value	Tons	Value
1865	[2]17,455	$943,617				
1866	6,525	346,673				
1867	11,493	527,529				
1868	12,180	559,062				
1869	10,315	473,459				
1870	9,888	567,373				
1871	8,180	516,158				
1872	8,171	538,714				
1873	7,735	621,353				
1874	6,911	726,899				
1875	8,432	709,553				
1876	7,272 [3]2,000	319,968 139,000				
1877	6,316	235,587				
1878	5,138	169,040				
1879	4,425	132,048				
1880	3,209	99,479				
1881	2,775	82,778				
1882	1,953	55,123				
1883	1,606	46,173				
1884	1,025	31,263				
1885	1,144	35,178				
1886	1,406	49,913				
1887	1,890	80,088				
1888	1,320	56,100				
1889	980	44,100				
1890	977	51,293				
1891	792	35,838				
1892	848	34,523				
1893	869	31,936				
1894	1,005	30,861	40,000	$44,000	762	$9,144
1895	1,100	36,000	41,000	41,000	750	8,250
1896	1.335	46,725	40,000	35,000	300	3,000
1897	3,605	135,185	25,000	18,500	300	2,000
1898	5,000	190,000			500	4,500
1899	4,780	245,000	16,600	18,675	100	700
1900	3,990	180,000	7,300	8,800		
1901	4,800	242,300				
1902	7,291	306,081				
1903	8,180	344,251				
1904	[5]8,480	314,000				
1905	7,764	279,651	15,000	15,000		
1906	7,203	262,909				
1907	7,675	292,878	8,453	8,453		
1908	9,600	405,792			2,000	8,000
1909	8,900	440,241			6,000	34,576
1910	10,800	488,700			12,000	50.000
1911	9.775	449.748			10,000	30,625
1912	9,743	409,596			8,000	32,000
1913	9,719	390,995			11,000	35,000
1914	6,633	325,349			7,000	21,000
1915	6,291	475,370				
1916	11,110	1,032,156				
1917	11,150	1,057,770				
1918	10,715	1,234,027				
1919	7,409	668,989				
1920	3,887	296,942				
1921	[6]					
1922	[6]					
1923	[6]					
1924	4,670	$320,758				
Totals	[6]345,840	$19,162,092	193,353	$189,428	58,712	$238,795

---

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.

[2] Production of New Idria Mine from 1858-1866; yearly details not obtainable, though New Idria began operation in 1850.

[3] Estimated output of Cerro Bonito, Monterey and Stayton mines. 1870-1877; yearly details concealed under heading of "various mines" in early reports.

COUNTY, 1865-1924.

Mineral water		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Gallons	Value		Amount	Value	Substance
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	
-----	-----	-----	58 tons	$2,280	Antimony.
-----	-----	$19,000	-----	-----	
5,000	$300	6,000	2 tons	70	Antimony
500	100	2,638	-----	-----	
900	450	[4]17,500	45 tons	135	Coal.
1,000	500	[4]25,240	19 tons	380	Asphalt.
10,000	3,750	13,000	100 tons	100	Limestone.
500	125	[4]12,794	-----	-----	
600	150	22,000	-----	-----	
10,000	400	23,200	-----	-----	
-----	-----	16,500	206 tons	2,472	Asphalt.
500	500	64,994	-----	-----	
2,600	3,120	23,000	-----	-----	
26,000	2,600	48,661	-----	-----	
26,000	2,600	63,220	-----	16,500	Gems.
3,120	1,560	83,709	-----	130,000	Unapportioned, 1900-1909.
3,500	1,400	94,243	-----	-----	
3,600	1,540	107,558	-----	-----	
26,000	1,240	83,232	-----	-----	
7,000	4,500	119,500	-----	-----	
700	280	110,630	-----	-----	
1,200	300	155,000	260 M. 2,500 tons	1,560 9,500 335	Brick. Dolomite. Other minerals.
[6]	-----	155,250	8,100 tons -----	25,515 526	Dolomite. Antimony and mineral water.
[6]	-----	101,148	----- 7,000 tons	59,245 15,000	Antimony, chromite, magnesite, mineral water Dolomite.
[6]	-----	103,295	130 tons 5,000 tons 5,340 tons -----	7,000 20,625 48,060 124,456	Chromite. Dolomite. Magnesite. Cement, manganese, mineral water.
[6]	-----	164,300	7,000 tons -----	24,500 418,687	Dolomite. Cement, magnesite, mineral water.
[6]	-----	207,250	18,000 tons -----	57,750 921,082	Dolomite. Cement, magnesite, mineral water.
[6]	-----	269,334	-----	1,116,759	Asbestos, cement, dolomite, magnesite, mineral water, quicksilver.
[6]	-----	259,805	6,650 tons	30,100 1,504,343	Dolomite. Asbestos, cement, magnesite, mineral water, quicksilver.
[6]	-----	424,854	-----	1,853,049	Asbestos, cement, dolomite, magnesite, mineral water, quicksilver.
[6]	-----	269,369	-----	1,554,476	Asbestos, cement, coal, dolomite, magnesite, mineral water.
[6]128,720	$25,415	$3,066,224	-----	$7,944,505	

---

[4] Includes bituminous rock.

[5] Flasks of 75 pounds since June, 1904; 76½ pounds previously

[6] See under 'Unapportioned.'

ANTIMONY.

The world consumption of antimony is comparatively small, being less than 2% of the consumption of copper, zinc and lead. Normally the price of antimony is about the same as that of lead and most of the time below that of copper, but the antimony market is recognized as one of the most unstable of any of the metals. From an average price of 6 to 7½ cents per lb. from 1908 to 1914 it advanced to 40 cents a lb. in 1916, due to the World War demand. Prices gradually declined from the high of 1916 to an average of 4.96 cents a lb. in 1921. Since 1921 the market has improved, becoming quite active in 1924, and during the last quarter of 1925 the metal was quoted at 24½ cents a lb. Present quotations (March, 1926) are 18½–20½ cents. On account of the small amount of antimony used in alloying with other metals consumers are not greatly concerned about the price they pay, and a steady fair price would be much more advantageous to producers than the widely fluctuating prices of the last 20 years.

There was a small production of antimony from San Benito County during the period of high prices in 1916, 1917 and 1918. Since then there has been no activity until the present year. All of the deposits are situated in the Stayton district (originally mined for quicksilver) on Antimony Mountain, in the northeastern corner of the county but also extending over into Merced County.

There appear to be at least three distinct lines of croppings that carry the antimony. The ore is stibnite, which occurs in lenses in a brecciated siliceous gangue, classified by different writers as trachyte, asperite and rhyolite.

Some of these deposits were located as mining claims and others are on patented lands not held under the mining laws. They have been described in earlier reports under various mine names, including Appeal Mine, Florence Mine Group, French Antimony Mine, Gleason Mine, Rip Van Winkle Mine, Shriver Mine, and others. At the present time the deposits within San Benito County are all on lands (ranches) that have passed into private ownership and none of them are held as mining claims.

The owners of these ranches are: T. H. French, of Hollister, who holds part of Secs. 19, 20, 21, 28, 29, 31, and 32, and all of Sec. 30, T. 11 S., R. 7 E.; Wiley Garner, of Hollister, whose holdings include the E½ of Sec. 6 and part of Secs. 7 and 8, T. 12 S., R. 7 E.; R. B. Knox, of San Francisco, part of Sec. 8, and all of Sec. 5, T. 12 S., R. 7 E.

Davis Antimony Lease. At the beginning of 1925 Mr. J. O. Davis, 1770 Arch Street, Berkeley, secured a lease on the entire Knox holdings, which include the Stayton Antimony Mine (Stayton Quicksilver Mine first located in 1870.

All ore which had been previously mined and was lying on the dumps was shipped out and Davis then began the systematic prospecting of the outcrops and ledges on the two mineralized zones trending across the property in a direction about N. 10° W. In doing this work several tons of high-grade stibnite have been segregated. Good ore was uncovered at 7 or 8 points on the ledges and a new lens was discovered near the south end of the property. The development has been sufficient to show that stibnite probably occurs in lenses of undetermined size, but more or less continuous, throughout the several thousand feet of ledge matter. None of the prospect trenches and holes are over a few feet in depth, but a large part of the ore exposed could be readily hand-sorted to a shipping product and much additional low-grade ore exists. The property is favorably located, being only 15 miles from Hollister by good mountain road with down-hill haul to the railroad.

On the *Wiley Garner Property*, adjoining the Davis lease on the west, considerable work has been done on a lens which strikes northwest. About 10 tons of 50% stibnite was shipped from surface working years ago. In 1915 Day and Underwood, of Hollister, drove a tunnel 10 feet below the upper workings and uncovered about three feet of nearly solid stibnite crystallized in fine needles. A shaft was later sunk 14 feet and a short drift at this level shows considerable antimony, indicating that this lens is of fair size. A number of surface showings have also been noted at other points, but they are mostly low grade. At one locality on Sec. 7, however, evidently an old prospect hole, some high-grade coarsely-crystalline stibnite was recently found. No work is being done on the Garner holdings, but negotiations are under way which may lead to renewed operations here, either in conjunction with the adjoining Davis lease or independently.

No work is being done on the *French Ranch*, which also contains portions of the mineralized ledges crossing the Knox and Garner holdings.

On the *Rancho Santa Ana y Quien Sabe* four miles south of Antimony Peak croppings of high grade stibnite have been reported, but there has been no attempt to develop them. Owners, De Laveaga Estate, Hollister, Cal.

Bibl: State Mineralogist's Reports VIII, p. 485; X, p. 516; XI, p. 371; XV, pp. 622–624. Bull. 38, p. 260. Preliminary Report No. 5.

ASBESTOS.

On the southwest slope of Sampson Peak and extending down Clear Creek toward Hernandez in the eastern part of T. 18 S., R. 11 E., there is a broad belt of serpentine which contains in places considerable chrysotile asbestos.

San Benito Asbestos Company. This company was organized in 1925, succeeding the California Asbestos Mining Company. Norris K. Davis, 400 7th Street, San Francisco, president. The property comprises six claims having a total area of 120 acres situated in Secs. 10 and 15, T. 18 S., R. 11 E., at an elevation of 3000 feet. The local address is Hernandez and there is a fair road following Clear Creek from there to the mine. The distance is approximately equal from the mine to King City on the west, or southeast to Coalinga, the nearest railroad points, it being about 35 miles either way.

The asbestos fiber varies from knife blade to $\frac{3}{4}$-inch in length. It occurs as veins and seam filling in the serpentine which is here considerably broken and shattered and quite soft in places. Mining is by open cut with hand-drilling and blasting. The crude material is trammed to the fiberizing mill in cars, where it is crushed and the asbestos fiber fluffed and separated. More than two years were spent in perfecting the mill which is constructed according to original plans of Mr. Davis and is patented. The final separation is by air. As the material has to be dry for proper milling, and artificial drying is not used, the mill can only be operated in the dry season. Electric power is used, furnished by the Coast Valleys Gas and Electric Company. At the time of visit no milling was being done, but one man was employed at the mine. The finished product is packed in 125-lb. sacks. The finely ground serpentine and dust which is carried by a conveyor to the dump has a consistency similar to low-grade ground soapstone and would probably have some value as a mineral filler if close to a market.

Other Deposits. At two or three other points along Clear Creek and south of it, desultory prospecting for asbestos has been carried on but nothing particularly encouraging has been opened up.

Bibl: State Mineralogist's Report XVIII, p. 214.

Asbestos fiberizing mill of San Benito Asbestos Company, San Benito County.

ASPHALT AND BITUMINOUS ROCK.

Asphalt has been commercially produced in a small way in the past from a portion of a deposit of bituminous rock situated in Secs. 32 and 33, T. 17 S., R. 8 E., 10 miles northeast of Metz.

Mathews Quarry. A small quarry in bituminous sandstone at this locality is owned by John Mathews of King City but it has been idle for a decade or more and on account of the small size of the deposit and distance from the railroad it is of little economic importance.

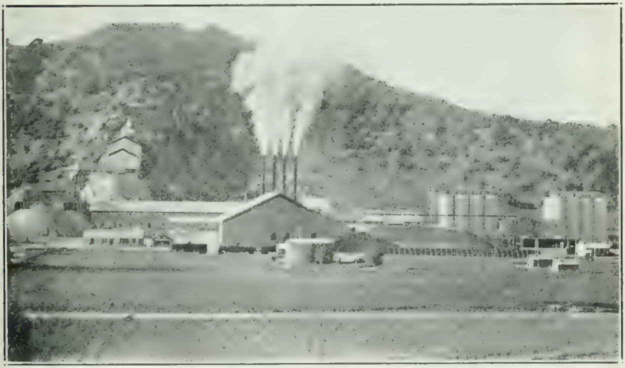
Another outcropping of asphaltum found on the Rancho El Gabilan, about two miles southwest of old Mission Portland Cement Company's quarries near San Juan Bautista, was discovered and prospected by H. V. Underwood of Hollister a few years ago, but the occurrence proved to be superficial.

Bibl: State Mineralogist's Reports XV, p. 624; XVIII, p. 214.
U. S. Geological Survey Annual Report XXII, Part I, p. 409.

BARITE.

The only known occurrence of barite in the county is on Gabilan (Fremont) Peak. The main body which was mined out between 1915 and 1920 was on the Monterey County side of the line near the summit.

Native Sons' Memorial Marker and base of flag pole on summit of Gabilan (Fremont) Peak. Barite is found within a few hundred feet of this point on Monterey-San Benito County line. Elevation 3169 feet.



Plant of Old Mission Portland Cement Company, San Juan Bautista, San Benito County. Photo by courtesy of the company.

It had a width of six feet, length of about sixty feet and was enclosed in limestone walls. The barite mined here was high-grade, coarsely crystalline and white grinding. A small lens was also mined on the northern side of the summit in San Benito County and it is possible that close search would uncover other bodies. It is twelve miles by fair road from San Juan Bautista to the summit of the peak which has an altitude of 3169 feet.

Bibl: State Mineralogist's Reports XV, p. 624; XVIII, p. 214.

CEMENT.

At the present time Portland cement is the most valuable individual mineral product of San Benito County. The output comes from a single plant which began operating in 1918.

Old Mission Portland Cement Company. Wm. F. Humphrey, president; J. A. McCarthy, vice president and general manager; C. B. Flick, Secretary; F. F. Parker, plant superintendent. Home office, 715 Standard Oil Building, San Francisco. The company's plant which is one of two in the state using the 'wet process' of manufacture of Portland cement is situated at San Juan Bautista. Operations began in 1918 and have been continuous ever since. The chief raw materials used, limestone and clay, are obtained on the company's property adjacent to the plant site, their holdings comprising approximately 2000 acres owned outright and mineral rights on 11,000 acres additional. Gypsum which represents 3% of the raw material consumed is obtained from Gerlach, Nevada.

The present limestone quarry is 3½ miles from the plant and the clay deposit about the same distance up San Juan Canyon, but at a lower elevation. On account of the natural composition of the limestone only a comparatively small amount of clay is mined.

At the limestone quarry Jackhammer air drills are used and after blasting the rock is loaded by steam shovel into 4½-yard cars and hauled by a gasoline locomotive three-quarters of a mile to loading bunkers. From these bunkers the limestone is conveyed by a surface tram 1300 feet long with a vertical drop of 700 feet to the lower bunkers from which it is taken by train to the plant.

Both the limestone and clay are delivered to the plant in trains of 4½-yard cars of 36″ gauge by a 20-ton oil-burning steam locomotive. The cars dump into a hopper feeding a No. 8 K Gates gyratory crusher. The material then goes to a No. 5 Jumbo Williams mill which discharges to a 24″ belt conveyor delivering to two storage piles. From storage the material is delivered by belt conveyor to three raw wet-grinding 7′ x 9′ ball-mills. Discharge from raw ball-mills is taken by screw conveyor and elevator to a raw tube-mill feed tank which feeds five 6′ x 22′ raw tube-mills. Tube-mill discharge passes by screw conveyor to mixing chambers, thence by a 3″ centrifugal pump to concrete slurry storage silos. A 6″ centrifugal transfer pump delivers the slurry to two 20′ deep by 28′ diameter concrete Dorr mixing tanks equipped with Dorr agitators. From the Dorr mixing tanks 2″ centrifugal pumps deliver the slurry to four kiln feed-boxes from which it is delivered by slurry feed-wheels to the feed pipes of the kilns. There are four 7′ x 150′ oil-fired rotary kilns which discharge to four 6′ x 50′ revolving coolers. The burned and partly cooled clinker is taken from the coolers by pan conveyor and delivered to a concrete clinker pit 20′ x 20′ x 15′ deep. A monorail conveyor with 1½-yard bucket transfers the clinker from the pit to ground storage. The same monorail bucket transfers the clinker from storage to the clinker ball-mill feed bin. If required, on account of getting wet in storage, the clinker is by-passed to a dryer bin, passed through a dryer and then delivered by elevator to the clinker ball-mill feed bin. The clinker ball-mill bin discharges to a pan conveyor, where gypsum from the gypsum bin is added, thence it is taken by elevator and drag conveyor to the finish ball-mill feed bin. The discharge from the finish ball-mill passes to an elevator discharging to an electric Hum-mer screen. The screen oversize is returned to the ball mill, the undersize passing by screw con-

Steinbeck Quarry, looking east. Locomotive and cars from Marble Falls Quarry. Old Mission Portland Cement Company, San Juan Bautista. Photo by courtesy of the company.

veyor to the finish tube-mill feed bins. There are five 6′ x 22′ finish tube-mills, the finished product from these mills passes by screw conveyor and then by an elevator and conveyor, or a cement pump (air), to concrete cement-storage silos. There are eight circular silos 20′ in diameter by 69′ high; eight, 21′ in diameter by 69′ high and three star bins. From the storage silos the cement is drawn by screw conveyors, then elevated and delivered to four bins feeding four Bates packers from which the sacked cement is transferred by conveyor, automatically counted, and delivered to railroad cars for shipment.

The entire plant is of concrete and steel construction and electrically operated, power being furnished by the Pacific Gas and Electric Company. Equipment includes all modern devices for the control of operations and production of the highest quality product. The California Central Railroad, a standard-gauge line 8 miles in length controlled by the company, connects the plant with the Southern Pacific main coast line at Chittenden. The plant has a daily capacity of 2300 barrels of cement and 175 men are employed.

Bibl: State Mineralogist's Reports XV, pp. 626–630; XVIII, pp. 215, 218.

CHROMITE.

No large deposits of chrome ore have been found in San Benito County, although the mineral occurs abundantly in the extensive serpentine area lying south of Idria, as small float and boulders. Natural erosion of the serpentine has concentrated this mineral in the ravines and stream gravels. Several carloads of the larger masses of chromite thus concentrated, were gathered and shipped out as early as 1875.

In 1917 various individuals living in that section collected small lots of chrome ore, some of which were sold to ore buyers and some still remains piled at various points. Most of it went out via Mendota, but a little was shipped through Coalinga, King City and Hollister. One lot seen at the Aurora Quicksilver Mine appeared to be of very good quality.

José Tirado, Hernandez, California, has a claim in this area on which there is said to be a good-size lens of chromite. It is adjacent to a road, but is idle as are all other chrome mining activities in the county at the present time.

Bibl: State Mineralogist's Reports IV, p. 136; VI, pt. I, p. 100; VIII, pp. 483, 490; XV, p. 630. Bull. 27, p. 126; Bull. 38, pp. 269, 362; Bull. 76, p. 166. U. S. Geol. Survey Bull. 603, p. 208.

CLAY.

The larger valleys of San Benito River and its tributaries and the surrounding foothills undoubtedly contain extensive deposits of clay, some of which may prove to be valuable for industrial purposes.

Dr. J. M. O'Donnell of Hollister owns a deposit along Bird Creek, three miles south of Hollister. The bed is exposed for a considerable depth in several of the gulches and a well was sunk 80 feet without reaching the underlying rock. The clay is light grey in color, very plastic and without grit. It burns to a cherry red and is said to be suitable for pottery use.

The *Alpine Quicksilver Mining Company* in 1915 burned about 260,000 brick in field kilns on lower Clear Creek near Hernandez for use in building their reduction furnace. The clay was dug locally. Some of these brick still remain along the road and appear to be of good quality.

M. A. Martin formerly of Hollister located some clay which burns white or nearly white near the head of Willow Creek in T. 15 S., R. 6 E.

H. V. Underwood of Hollister has submitted samples of plastic clay of fairly high alumina content found at several points in the county.

There is a deposit of clay containing considerable sandy material on the *C. H. Abbe Ranch* 12 miles south of Paicines on the Idria road. This clay fuses at a rather low temperature but does not crack or swell. It appears to be on the order of an impure montmorillonite. The bed stands practically vertical and cuts across a ridge from top to bottom. The spring mentioned under 'Mineral Water,' on the Abbe property issues near the base of this clay bed.

A white kaolinized rock that slowly breaks down in water forming a slightly plastic clay with a comparatively low fusing point is exposed in a cut along the San Benito road about 18 miles south of Tres Pinos. This variety of clay could probably be utilized in the ceramic industries. It is undeveloped.

W. T. Maeder, 554 66th street, Oakland, California, has submitted a sample of siliceous clay, possibly a fire clay, from the Bitterwater section. Undeveloped.

There has been no commercial output of clays, as such, in the county, and the only clay material being utilized at the present time is that mined by Old Mission Portland Cement Company for the manufacture of cement at their plant at San Juan Bautista.

The clay resources of the county have not as yet been fully ascertained or closely investigated. Additional data will be contained in a new bulletin to be issued by the Bureau on the Clay Resources of the State, which is now in course of preparation by the author, Mr. W. F. Dietrich, Ceramic Engineer.

Bibl: State Mineralogist's Report XV, p. 630. Bull. 38, p. 226. Preliminary Report No. 7, p. 91.

COAL.

Coal prospects have been noted at many points in the sedimentary rocks of the county, but at only a few places have important deposits been opened up. Lignite, some of which is of the jet variety, and subbituminous and bituminous coal occurs, and the deposits are of such size in a few cases as to rank among the best in the state. Although distance from transportation has handicapped their profitable exploitation, there can be no doubt as to the potential value of the coal in this county.

The only deposits that have been developed to any extent are the Mascovich mine and that of the San Benito Coal Mining Co., both in the southern end of the county.

Mascovich Coal Mine (formerly *Trafton Mine*). Owner, N. P. Mascovich, Rt. A, Box 19, Gilroy, California. The mine is situated near the head of James Creek at an elevation of 2300 feet, in Sec. 21, T. 17 S., R. 10 E. It was first opened by Trafton in 1870. He drove one shaft on the vein, but only made a small production, after which the mine laid idle for many years. About 1907 it was taken under lease by the Monterey Coal Co. This company did some work in the old shaft and also put down another to a depth of 70 feet. The mine was equipped with a steam-boiler, engine and hoist, using coal from the mine for fuel. Their operations were not a financial success, however, and the mine reverted to the owner. Mascovich continued the shaft started by the Monterey Coal Co. to an incline depth of 158 feet. He also drove a tunnel 80 feet, connecting with the bottom of the shaft for drainage purposes, but this tunnel is bulkheaded and the water allowed to stand in the shaft. At the time of visit it was within 20 feet of the collar. Another cross-cut tunnel was started 250 feet lower down the hillside, which will give about 500 feet of backs if continued until it taps the vein.

The coal vein outcrops plainly along the hillside where it can be readily traced for 1200 feet. The strike is nearly north and the dip 37° to 40° W. Underlying the coal is a thin stratum of bituminous sandstone, below which is a heavy bed of dark grey sandstone. The roof is shale, overlain by 10 feet of sandstone. Above this there is another 6″ to 8″ vein of coal, overlain by alternate strata of shale and sandstone with some conglomerate.

The shaft, which is 5′ by 8′ in cross-section, with an inclination of 37½°, is sunk directly on the vein. Where the coal is exposed above the water level it is standing perfectly, and there are no signs of disintegration or softening deeper than one-half inch from the surface, although it has been standing exposed to the air for years. Analyses show the coal to contain 54% fixed carbon and to have a heat value of 13,220 B. t. u. or 7345 calories. It no doubt compares favorably with any other coal in the state, and the thickness of the vein and its position with reference to the proposed lower tunnel would permit cheap mining. All equipment except the boiler has been removed since the last work in 1913, and the upper end of the road has not been kept in repair, but a car may still be driven to within one-quarter mile of the workings. As a solution of the transportation problem, it has been suggested that powdered coal for industrial plants might be produced at the mine and transported by pipe-line to the nearest railroad point 22 miles distant, using air as the carrying medium.

San Benito Coal Mining Co. John J. Shoo, president, 542 Lakeshore Boulevard, Oakland; Earle D. White, secretary and treasurer, Bank of Italy Building, Oakland. The deposit owned by this company was discovered about 20 years ago and some coal was mined and sold to the New Idria Quicksilver Mining Co. Since that time the mine remained idle and the workings flooded until taken over by the present company in August, 1921.

The property comprises 280 acres of patented land and other holdings on Larious Creek near the Ashhurst Ranch in T. 17 S., R. 11 E., in the New Idria district. Mendota, the nearest railroad point, is 33 miles distant. Llanada is the local post office.

The mine was equipped with a gas engine and blower, track, cars, and hand tools, and development began in 1922. Work has been carried on intermittently during the past several years, but there has been no commercial production to date, and the mine is at present shut down.

The coal so far exposed is sub-bituminous in character and occurs in veins from 2½ to 7½ feet in thickness between sandstone walls. Three veins are known and have been traced for several miles on the surface. A tunnel 200 feet in length cuts a vein 6 feet wide at a depth of 70 feet from the surface, and another tunnel about 700 feet in length, one mile distant, has cut the first vein. The coal dips at an angle of 60° to 70°. An analysis shows the following content:

	Per cent
Moisture	8.6
Volatiles (including sulphur 2.58%)	49.5
Fixed carbon	36.6
Ash	5.3
B. t. u. 10750	

Another sample from near the surface analyzed by Smith, Emery & Co., August 16, 1921, gave:

	Per cent As received	Per cent Dry
Moisture	9.45	----
Volatile and combustible matter	43.96	48.55
Fixed carbon	36.39	40.51
Ash	9.90	10.94
Sulphur 2.90%		
Calories	5514	6089
B. t. u.	9925	10961

Bibl: State Mineralogist's Reports IV, p. 14; V, p. 104; VI, p. 117; VIII, p. 483; XI, p. 372; XII, p. 61; XIII, p. 54; XV, p. 631; XVIII, pp. 145, 146. U. S. Geol. Survey Bull. 431, p. 243; Bull. 585, p. 29; Bull. 603, p. 209. U. S. Bureau of Mines Bull. 22, pp. 53, 396.

COPPER.

There is no recorded output of copper from San Benito County, but prospects have been located at several points and considerable development work has been done at various times beginning in the eighties.

Antelope Copper Mine. This discovery was made in 1887. The mineralized formation appears to be a compact fine-grained sandstone or sandy slate impregnated with copper and iron. The dip is to the southeast but the strata are much broken and disturbed. The principal mineralization is in streaks along joint planes which occasionally develop into nodules and pockets of good ore carrying oxide and carbonate of copper and iron-oxide. Some of this ore from which the sacks have rotted away is still lying on the dump.

The early workings which are badly caved consisted of two inclines, one about 400 feet in length running a little west of south and apparently passing through and then continuing below the mineralized zone; the other, about 40 feet farther down the hill, was 100 feet in length but did not reach the ledge.

The property was abandoned for years but was relocated recently by H. V. Underwood, E. A. and R. W. Mathews, address H. V. Underwood, R. F. D., Hollister, California. They have located three claims, a total of 60 acres, being situated in Sec. 4, T. 15 S., R. 9 E., 25 miles south of Tres Pinos and not far from the Idria road, at an elevation of 2500 feet. Juniper and oak cover the hills. There are springs nearby and a little water seepage from one of the mine tunnels. The new owners have driven an incline at an angle of about 10° from the horizontal running a little south of east for 200 feet and this incline passes through the copper-bearing formation at a slight angle for a distance

Antelope Copper Mine, San Benito County.

of approximately 60 feet. A winze 10 feet deep 100 feet in, is still in the ledge matter indicating a zone of mineralization at least 20 feet thick. The walls of this working are covered with a thin scale of green chalcanthite, a hydrous sulphate of copper which is a common evaporation product resulting from the alteration of copper sulphides. Nodules and bunches of oxidized copper minerals also occur in seams in the rock. The green chalcanthite may be scraped from the walls, and carries a high percentage of copper which can be leached out by water. Chalcanthite is usually an unimportant ore of copper but it is probable that some copper could be produced here by a simple acid or water leaching process. Idle except for assessment work.

Copper Mountain Mining Company, F. H. Melville, president, controlled for many years a large property at the Palisades and Pinnacles, San Benito County. Their holdings included 26 lode claims; also the SE¼, Sec. 33, T. 16 S., R. 7 E; the NW¼ of SW¼; SW¼ of NW¼ and N½ of NW¼, Sec. 34, T. 16 S., R. 7 E., covering townsite, millsites and water right.

The claims cover a mineralized zone mainly in coarse-grained granite with feldspar predominating in many places. The zone is marked in places by iron gossan and the granite is more or less stained with copper carbonate. Chalcopyrite is rarely visible and some gray copper mineral has been noted. Assays were said to show 3% copper with small gold and silver values. Molybdenite is sparsely disseminated in the granite in places. In one tunnel a lens of feldspar 30 feet in thickness was cut.

The company has been in almost continuous litigation with various individuals and the Department of the Interior over the question of the mineral or non-mineral character of the land, on account of the location of their holdings controlling the western entrance to Pinnacles National Monument and the desire of the government to develop the land for public use.

With the reported recent ousting of the mining company from all right and title to the ground by decision of Land Office officials and approval by the highest authority, the final chapter in this litigation appears to have been written and obviously no further attempt can be made to develop a mine here.

Lewis Creek Claim. Some development work including a tunnel 100 feet in length was done on a claim near Lewis Creek in Secs. 2, 3 and 4, T. 19 S., R. 10 E., about 20 years ago, but no ore was developed. Idle for years.

DIATOMACEOUS EARTH.

No deposits of this material have been developed within the county although several occurrences have been reported. It is found on the *Leonard Estate* in Sec. 28, T. 17 S., R. 8 E., and on adjacent sections outcropping in rounded knolls for a distance of over a mile. A deposit has also been noted near San Benito on the *N. D. Page Property*, and it occurs on the holdings of *Thos. Melendy* interstratified with narrow veins of gypsum in Sec. 28, T. 17 S., R. 8 E. Metz, the nearest railroad station, is ten miles distant. As there are large deposits of diatomaceous earth in other counties that lie adjacent to rail or water transportation, there is little likelihood of any immediate development in this county.

Bibl: State Mineralogist's Reports XV, p. 636; XVIII, p. 217.

DOLOMITE.

Dolomite of good quality is associated with the limestone deposits in the foothills of the Gabilan Range, in the Cienega district southwest of Hollister. There has been a fairly consistent annual production for the past ten years, the material being used mainly for the making of refractory basic linings in open-hearth steel furnaces.

Quarries have been opened up and production has come from the *O'Hara Ranch Deposit*, 11 miles southeast of Hollister; from the property of the *San Benito Vineyards Co.*, 10 miles southeast of Hollister; from the adjacent *Leopold Palmtag Property* and from the *E. L. Martin Ranch Deposit*, 8 miles southwest of Hollister.

Dolomite Quarry in Cienega Del Gabilan District, San Benito County, operated by A. E. Hamilton, Hollister, Cal.

Recently one of the larger San Francisco consumers has acquired a deposit in Monterey County from which it is drawing its supply, and this action has curtailed production from the San Benito quarries. At the present time only one deposit is being worked.

Hamilton Quarry. This is on property now owned by Mortimer Fleischhacker of San Francisco, but formerly a portion of the San Benito Vineyards Co's. holdings. A. E. Hamilton, Hollister, California, is operating it under a lease with a small crew of men. The dolomite is blasted loose after hand-drilling, or broken down with bars and picks, and shoveled into 5-ton trucks. There is a good road to Hollister and a loading platform there from which the trucks dump direct to railroad cars. About one car every three days is now going out. Besides operating this lease, Mr. Hamilton owns the former *McBurney Property* in T. 14 S., R. 5 E., in the same vicinity upon which both limestone and dolomite occur.

Bibl: State Mineralogist's Report XV, pp. 633-636.

GEMS.

The discovery of a new gem mineral in San Benito County in 1907 created considerable scientific interest at the time but little has been accomplished in commercializing the product. The mineral, which was named Benitoite, is a titano-silicate of barium ($BaTiSi_3O_9$). It is transparent, the color varying from colorless to deep blue; hardness 6.5 and sp. gr. 3.64—3.65. The benitoite occurs with natrolite and neptunite in a zone of narrow veins in serpentine.

Dallas Mining Company. The deposit is covered by two patented mining claims owned by the Dallas Mining Company, R. W. Dallas, president, Coalinga, California. They are in Sec. 25, T. 18 S., R. 12 E., 12 miles southeast of Idria, at an elevation of 4600 feet.

In 1920 the mine was leased to the San Benito Gem Company, B. C. Suit, president, Hollister, California, but the property has remained idle.

Bibl: State Mineralogist's Report XV, p. 636. Bull. 67, p. 157. Bull. Dept. Geol. Univ. of Cal., Vol. 5, pp. 149, 331. U. S. Geol. Survey Bull. 603, p. 208. Mineral Resources 1909, Pt. II, p. 742. Am. Jour. Sci., Vol. 27, p. 398. Science, 1908, p. 616.

GOLD.

The extent of the county's mineralization is emphasized by recording the fact that gold has been found in place at several localities in sufficient quantity to encourage the expenditure of considerable money in carrying on prospecting operations. However, all such attempts have been long since abandoned, and hope of commercially producing gold has ended. In the eighties an attempt was made to do some placer mining in the Panoche Valley, but nothing was accomplished.

The *Chalone Mine* and *Defiance Mine* were opened by Thos. Flint of Hollister in 1890. The properties were situated on a volcanic ridge northeast of North Chalone Peak in Sec. 14, T. 17 S., R. 7 E. Some assays as high as $94 per ton were obtained here and numerous samples showed from $1 to $5 per ton. A tunnel was driven in 540 feet on the Chalone and another 400 feet on the Defiance but no distinct orebodies were found, the gold apparently being a primary constituent of the unaltered country rock. On account of the discouraging results of the work the properties were soon after abandoned.

A sample of andesitic rock taken from the surface at a point 3 miles south of the above workings by L. H. Day of Hollister was also reported to show some gold content.

Small ledges in a hill on the *Flint Estate* in San Juan Canyon, west of Hollister, gave samples assaying as high as $25 to $30 per ton and a tunnel 300′ in length was driven here but only narrow stringers carrying little or no gold values were found at depth and work was abandoned in 1896.

Bibl: State Mineralogist's Reports VIII, p. 490; XII, p. 227; XIII, p. 318; XV, p. 637.

GYPSUM.

There has been a large tonnage of gypsum produced in San Benito County, some of which undoubtedly has not become of record. Part of the output was also credited to Monterey County, as it was shipped from King City. The deposits are far from exhausted, but there has been no activity in this branch of mining for the past 10 years.

The most important deposits are found in the Topo and Bitterwater section where gypsum beds form a conspicuous part of the sediments that mantle large areas. Workable deposits are mainly of the massive grey variety in the form of gently inclined beds. These are in places several hundred acres in extent, but are often cut into smaller residual hills by erosion. Some development work has been done on deposits in Sec. 5, T. 19 S., R. 10 E.; in Sec. 32, T. 18 S., R. 10 E.; Sec. 15, T. 18 S., R. 9 E.; Secs. 8 and 17, T. 18 S., R. 9 E.; Sec. 11, T. 18 S., R. 10 E., and at other localities in this region, which are described in earlier reports mentioned in the bibliography.

Lyons Gypsum Co. The largest output has come from quarries located in Secs. 8 and 17, T. 18 S., R. 9 E., 13 miles east of King City. They were formerly known as the Dunne Gypsum Quarries, but are now controlled by the *Lyons Gypsum Co.*, T. W. G. Lyons, president, King City. Considerable production has also come from quarries on the Tannehill Ranch, 12 miles east of King City on Bitterwater road, which were leased by T. W. G. Lyons.

The gypsum bed on the Lyons Gypsum Company's property is covered by an overburden 6 to 12 feet in depth, which was removed with 2-horse scrapers. The underlying gypsum bed averaged six feet in thickness. It was blasted out and broken in blocks convenient for handling and hauled to King City for shipment.

Bibl: State Mineralogist's Reports VIII, p. 490; XIII, p. 504; XV, pp. 638-639. Bull. 38, p. 287.

IRON.

Surface indications of iron deposits, both hematite and magnetite, have been noted at several places in the county, but none of them have been developed.

Hematite croppings have been reported in Sec. 6, T. 15 S., R. 6 E., two miles south of the old lime kilns of the Cienega Lime Co. and 15 miles from Tres Pinos. Indications have also been mentioned as occurring in T. 17 S., R. 12 E., and in the country between Stayton and Panoche Pass.

There is a small iron gossan on the Antelope Copper Mine claims in Sec. 4, T. 15 S., R. 9 E.

Bibl: State Mineralogist's Reports VIII, p. 490; XV, p. 639. Bull. 38, p. 299.

LIME AND LIMESTONE.

Massive crystalline limestone of good quality, suitable for the manufacture of lime and cement and for other industrial purposes, outcrops prominently along the Gabilan Range from San Juan Bautista to the region around Pine Rock in T. 16 S., R. 8 E.

This limestone is in part dolomitic and in places deposits of pure dolomite occur. The deposits have been long known but only a few of them have been developed to any extent. Lime has been made at several places in the past and some of the old kilns are still standing, but no lime has been burned here for the past twenty years. The only producing quarries at the present time along this belt are those of the Old Mission Portland Cement Company producing limestone for their plant at San Juan Bautista, and a dolomite quarry operated by A. E. Hamilton (see under dolomite).

All other deposits are lying idle in a more or less undeveloped state although there has been some changes in ownerships since former reports were issued.

Henry Cowell Lime and Cement Company, No. 2 Market St., San Francisco, owns 1044 acres of land containing extensive deposits of limestone in Secs. 28, 29, 30 and 32, T. 14 S., R. 6 E., and Secs. 14 and 24, T. 14 S., R. 5 E., about thirteen miles from Tres Pinos in the vicinity of Thompson Creek. About 26 years ago the Cienega Lime Company operated four kilns of 50-barrel capacity each on this property, but there has been no production since the property was acquired by the present owners.

D. F. H. McPhail, Hollister, California, owns 245 acres of land in Secs. 23 and 13, T. 14 S., R. 5 E., 14 miles southeast of Tres Pinos. A tract of 81 acres in Sec. 23 contains a particularly bold outcropping, the limestone standing up possibly 150 feet above the base in places. Various analyses have shown the material to contain 96% $CaCO_3$ and from 2½% to 4% $MgCO_3$. The property is for sale.

D. F. H. McPhail, U. G. Harlan, et al., of Hollister, also own considerable acreage in Secs. 23 and 24, T. 14 S., R. 5 E., containing limestone and on which lime was burned at one time.

Old Mission Portland Cement Company. This company owns 2000 acres and the mineral rights on 11,000 additional acres covering their plant site and limestone deposits in the Cienega del Gabilan district near San Juan Bautista (see under Cement).

San Benito Lime Deposit, also known as the Connelly and Kruse limestone deposit, is situated in Sec. 23, T. 14 S., R. 5 E., adjacent to the McPhail holdings. The property has recently been purchased by Hamilton, Fontaine and Temple, address A. E. Hamilton, Hollister, California, or Temple and Hamilton, 1st and Santa Clara Streets, San Jose, California.

The new owners contemplate installation of kilns and production of lime in the near future.

Bibl: State Mineralogist's Reports VI, pp. 28, 29; VIII, p. 488; XII, p. 393; XIII, p. 629; XV, pp. 626, 633, 640; XVIII, pp. 217, 218. Bull. 38, p. 76.

MAGNESITE.

Production of magnesite began in 1917 in San Benito County. The deposits so far developed are all in Secs. 34, 35 and 36, T. 17 S., R. 11 E., on a high spur running westerly from Sampson Peak and lying between two forks of Larious Creek at an elevation of 3900 feet.

Sampson Magnesite Mine (Maltby No. 3 Mine) comprises 21 claims. It is equipped with a rotary kiln and aerial tram 5000 feet in length for delivering the ore from the mine on top of the ridge to the furnace. It is being operated under lease by C. S. Maltby, Humboldt Bank Building, San Francisco, and ranks as one of the state's important producing properties.

Superior Magnesite Co., organized by H. A. Palmer, et al., of Hollywood, has acquired the Standard Group of 11 claims adjoining the Sampson Peak Mine, and are installing machinery for operating. As the magnesite mining industry of the state is described in detail in a special bulletin[1] published during the latter part of 1925, which includes operations in San Benito County, the properties were not visited during the present survey.

Bibl: State Mineralogist's Reports XV, pp. 643–645; XVIII, pp. 218–219; XIX, p. 26; XX, p. 28; Bull. 79. U. S. Geol. Survey Bull. 355, p. 38; Bull. 540, pp. 503–509; Bull. 603, p. 208; Min. Res. of U. S., 1911, Pt. II, p. 1120.

MANGANESE.

San Benito County was not an important producer of the 'war minerals' manganese or chrome, even during the period of high prices and urgent demand preceding the signing of the armistice. Since then there has been no activity whatever at the several manganese deposits which were more or less developed and from which a small amount of manganese ore was produced. The deposits are all in the Diablo Range in the eastern portion of the county, and have been described in detail in Bulletin 76, 'Manganese and Chromium in California,' 1918.

Fries Ranch Manganese Deposit is associated with red jasper outcropping in Secs. 5 and 8, T. 13 S., R. 8 E., 18 miles by road east of Tres Pinos.

Hannagan Ranch Manganese Deposit occurs in the SW$\frac{1}{4}$ of Sec. 22, T. 15 S., R. 9 E., and is about 31 miles by road southeast of Tres Pinos near the west end of Big Panoche Valley. Three feet of good ore was exposed here.

Hawkins Ranch Manganese Deposit is in Sec. 35, T. 11 S., R. 6 E., 13 miles northeast of Hollister. Some ore averaging over 40% metallic manganese has been shipped from this property.

Hendricks Mine. This property comprises 80 acres of patented land in Sec. 24, T. 13 S., R. 8 E.; D. F. H. McPhail, agent, Hollister, California. It is 23 miles east of Tres Pinos by good road and lies close to the Merced County line. A good-sized orebody is exposed here, which is said to have been first opened up over 35 years ago.

Lewis Ranch Manganese Deposit. This is a small deposit in Sec. 7, T. 13 S., R. 8 E., adjoining that on the Fries Ranch.

Bibl: State Mineralogist's Reports XII, p. 330; XV, p. 644. Bull. 38, p. 336; Bull. 76, pp. 59–61.

---

[1] Bradley, W. W., Magnesite in California, Bulletin No. 79, 1925.

MINERAL WATER.

Abbe Spring. There is a small spring on the property of C. H. Abbe, 12 miles south of Paicines on the Idria road, the water of which is mineralized, as indicated by its taste, and which is considered 'not fit to drink' by the owner though used for watering cattle. All vegetation is killed where the water flows upon the ground. An analysis of the water has never been made.

San Benito Mineral Spring. Owner, E. J. Anderson, Rt. 1, Box 150, Hollister, California. This property comprises 160 acres, situated on the Southern Pacific railroad, four miles southeast of Hollister, the springs being a flag stop. The paved highway to Tres Pinos also passes the property. The water is obtained from a well 286 feet deep, drilled about 1890. It rises to within 100 feet of the surface from which depth it has to be pumped. As indicated by the following analysis, by M. E. Jaffa, the water contains a large amount of the sulphate radical which it is claimed gives it definite medicinal effects.

Properties of reaction:	
Primary salinity	85
Secondary salinity	0
Tertiary salinity	0
Primary alkalinity	7
Secondary alkalinity	8
Tertiary alkalinity	?

Constituents in parts per million:	By weight	Reacting values
Sodium (Na) Potassium (K)	780	33.94
Calcium (Ca)	29	1.46
Magnesium (Mg)	18	1.50
Iron (Fe)	8.9	.32
Sulphate (SO_4)	736	15.32
Chloride (Cl)	566	15.97
Carbonate (CO_3)	178	5.93
Silica (SiO_2), organic matter and combined water	188	
	2,503.9	

There is a small bath house at the spring. The water is used locally to some extent but is not bottled or sold on a commercial scale, and practically no effort has been made by the present owner to develop the property into a health resort. Parties are at present negotiating for a lease, which if granted will probably result in further improvement.

Bibl: State Mineralogist's Reports XIII, p. 516; XV, p. 645.
U. S. Geol. Survey W. S. Paper 338, p. 306.

PETROLEUM.

Prospecting for, production and refining of mineral oil differs so radically from other forms of mining that it is usually treated as a distinct and independent industry. It requires specialized study for proper presentation, and therefore, the petroleum resources and possibilities of the county are not included in this report.

Seepages of oil and gas have been long known to exist in a number of localities and considerable drilling has been carried on, but to date without commercial production resulting. The geology and oil possibilities in this area are discussed in detail in the publications listed in the bibliography, to which the reader is referred. Current oil field operations are reported in 'Summary of Operations, California Oil Fields,' published monthly by the Department of Petroleum and Gas of the State Mining Bureau.

The following data regarding prospect wells drilling within the county from 1914 to 1924, inclusive, are from records compiled by the State Oil and Gas Supervisor:[1]

Company	Well No.	Sec.	Twp.	Range	Date started	Depth
Hamiltonian Oil Company	1	19	16 S	11 E	1922	225
S. F. Panoche	------	13	16 S	10 E	1922	------
Merced Paraffine Oil Company	1	8	17 S	11 E	Prior 1916	1500
Union Oil Company of California	'Griffin' 1	36	18 S	9 E	1921	3480
Standard Oil Company	La France	33	17 S	9 E	1914	2408
Standard Oil Company	'Stone' 1	27	17 S	8 E	Prior 1915	------
Standard Oil Company	Leonard 1	28	17 S	8 E	Prior 1915	------
Petroleum Midway Limited	1	10	12 S	4 E	1924	5200
Watson, Douglas S. (Breacita Oil Company)	1	5	12 S	4 E	1922	3297

Bibl: State Mineralogist's Reports VIII, p. 488; XI, p. 372; XII, p. 356; XV, p. 646. Bull. 19, p. 148; Bull. 69; Bull. 89, pp. 69–82. U. S. Geol. Survey Bull. 431; Bull. 581d; Bull, 603; Monograph XIII.

QUICKSILVER.

San Benito County, due mainly to operations at the New Idria Mine, has been the leading quicksilver producing center, not only in California but in the United States, for the last 20 years.

The quicksilver mining industry of the county has been comprehensively described in Bulletin No. 78, 'Quicksilver Resources of California,' by Walter W. Bradley, 1918. This bulletin discusses the geology and ore occurrences in the several districts in the county, lists the mines, and contains data covering their history, development, equipment, possibilities and metallurgical practice. It also contains maps of the districts and a complete bibliography referring to the separate properties and to the general subject in all its phases.

As Bulletin No. 78 is still available and there has been little change in the status of most of the mines, detailed descriptions will be omitted in this report and only such changes in ownership and new developments as were found are given herein.

Alpine Mine. This property which formerly consisted of 32 full claims in Secs. 13 and 14, T. 18 S., R. 11 E., owned by the Alpine Quicksilver Mining Company, one time called the Esmeralda Quicksilver Mining Co., is now owned by H. B. Leonard, San Benito, California. All claims except three have been abandoned. A new plant completed in 1916 included an improved Scott furnace of 20-ton capacity and seven brick condensers. It was only operated a few months and has been closed down since the summer of 1917. The mine is idle except for assessment work.

Bibl: State Mineralogist's Report XV, pp. 649–651; Bull. 78, pp. 96–98.

---

[1] Bush, R. D., Results of Wildcat Drilling in California, 1914–1924, 'Summary of Operations, California Oil Fields,' Vol. 11, No. 1, July 1925.

Andy Johnson and *Fourth of July Mines* (Flint Group). This patented property consisting of 552 acres in Secs. 2, 11, 12 and 13, T. 18 S., R. 11 E., and Sec. 18, T. 18 S., R. 12 E., owned by Thomas Flint of Hollister, has remained idle since lessees ceased work in November, 1917.

Bibl: State Mineralogist's Report XV, p. 654; Bull. 27, pp. 131, 137, 138; Bull. 78, pp. 98–99. U. S. Geol. Survey Mon. XIII, p. 309. Geol. Survey of Cal., Geol. Vol. II, p. 123.

Aurora Group. No new developments have taken place at this property in Sec. 5, T. 18 S., R. 12 E., and Secs. 11, 12, 13 and 14, T. 18 S., R. 11 E. It has remained idle since July, 1917.

Bibl: State Mineralogist's Report XV, p. 652; Bull. 27, p. 131; Bull. 78, pp. 99–100. Min. Res. W. of Rocky Mts., 1874, p. 381. U. S. Geol. Survey Mon. XIII, pp. 309, 466; Min. Res. 1914, Pt. 1, p. 326; 1915, Pt. 1, p. 269. Geol. Surv. of Cal., Geol. Vol. II, p. 120.

Bonanza Group. Formerly consisted of 2 claims in Sec. 29, T. 18 S., R. 12 E., owned by Bonanza Quicksilver Mining Company. One claim has been abandoned and the other is now owned by Ramon Tirado, Hernandez. Assessment work is kept up and some good showings of ore are said to have been uncovered in doing this work.

Bibl: State Mineralogist's Report XV, p. 653; Bull. 78, pp. 100–101.

Bradford Mine (Cerro Gordo). In Secs. 3, 4, and 9, T. 15 S., R. 8. E. Last work by J. F. Tatham, lessee, Almaden Road, Los Gatos. Idle for past ten years.

Bibl: State Mineralogist's Report XV, p. 653; Bull. 27, pp. 131–133; Bull. 78, p. 101.

Butts Mine. Wm. Butts, owner, Pine Rock, via Tres Pinos. Located in Sec. 4, T. 16 S., R. 8 E. No production reported since 1915.

Bibl: State Mineralogist's Report XV, p. 654. Bull. 27, p. 133; Bull. 78, pp. 101–102.

Cannon Mine. A prospect in Section 4, T. 15 S., R. 8 E.

Bibl: State Mineralogist's Report XV, p. 654. Bull. 27, p. 133; Bull. 78, p. 102.

Cerro Bonito Mine. Patented property in Sec. 31, T. 15 S., R. 10 E., owned by Cerro Bonito Quicksilver Mining Company, Thomas Flint, president, Hollister, California. No activity for many years.

Bibl: State Mineralogist's Report XV, p. 654. Bull. 27, pp. 134–137; Bull. 78, pp. 102–103. Min. Res. W. of Rocky Mts., 1875, p. 14.

Don Juan and Don Miguel Mines. A patented property in Sec. 36, T. 18 S., R. 11 E., and Sec. 31, T. 18 S., R. 12 E., owned by W. A. Breen, Hernandez, California. Idle.

Bibl: State Mineralogist's Report XV, p. 654. Bull. 27, p. 137; Bull. 78, p. 103.

Florence Mack Mine. Owner, C. P. Smith, Hernandez, California. This property, consisting of 6 claims in Sec. 32, T. 18 S., R. 12 E., is on upper San Benito River 10 miles above Hernandez and not on Saw Mill Creek as erroneously stated in earlier reports. The owner and one man are carrying on development work, and have exposed considerable good ore. There is also about 7000 tons of low-grade ore on the dump, which could probably be concentrated. One flask of metal was produced during the summer of 1925, by retorting. The property is open for negotiations leading to its working.

Bibl: State Mineralogist's Report XV, pp. 655–657. Bull. 78, pp. 103–105.

French Ranch (see under Antimony).

Hernandez Quicksilver Mining Company. (Picachos Mine.) M. G. Ramirez, president, San Juan Bautista, Cal. The Picachos Mine is a patented property in Secs. 19 and 20, T. 18 S., R. 12 E., a producer in the past and containing a large tonnage of low-grade ore, indicated by panning tests at many points. The company lacks finances to install an adequate reduction plant and are open for negotiations with capital. Idle since 1916.

Bibl: State Mineralogist's Report XV, p. 658. Bull. 27, p. 145; Bull. 78, pp. 105–107. Geol. Surv. of Cal., Vol. II, p. 121. U. S. Geol. Survey Mon. XIII, pp. 309–466.

Lone Star Mine. A prospect on Los Muertos Creek, 18 miles southeast of Tres Pinos. Idle.

New Idria Quicksilver Mines, Inc. Ernest B. Dane, president; James D. Colt, secretary; Home Office, 6 Beacon St., Boston, Mass. San Francisco Office, Merchants Exchange Bldg., W. R. Moorehead, general manager; C. D. Richardson, superintendent, Idria, California. The New Idria property has produced approximately 98% of the recorded output of quicksilver from San Benito County, and it ranks second in total production of quicksilver in North America, being exceeded only by the New Almaden Mine in Santa Clara County.

The mine as of 1918 is fully described in Bulletin 78, but there have been some important changes since that publication was issued, including reorganization of the company, installation of additional rotary kilns, electric power line and many minor betterments.

A disastrous fire on June 20, 1920, destroyed the tramway terminals, ore bins and crushing plant, warehouse, blacksmith shop, old reduction furnaces and electrical equipment required for operation of the new rotary furnaces some of which were already installed.

This fire and the unsatisfactory condition of the quicksilver market due to the after-war slump in prices which carried them below the cost of production at most mines, resulted in the closing down of the mine in November, 1920. The New Idria Quicksilver Mining Company's affairs were liquidated and it was succeeded by the New Idria Quicksilver Mines, Inc., organized December 23, 1922. Rebuilding of the surface equipment and completion of the rotary furnace installation had been carried on in the meantime. Operations were resumed by the new company on April 25, 1923, and have been continuous ever since. Electric power for all purposes is now supplied by Coast Valleys Gas and Electric Company over a new transmission line from King City, 56 miles distant, at 33,000 volts. This is stepped down to 440 volts at the substation by three 150-k.v.a. Malony transformers. From here a line carrying 2300 volts runs to Camp No. 2, the upper workings of the New Idria, where it is transformed to 440 volts.

There has been little change at Camp No. 3 (San Carlos workings) where mining by the quarry system continues with transportation by aerial tramway to the crusher ore-bins.

Camp No. 2 (upper workings of New Idria) is also an open quarry system operation, the ore being transported to the crusher ore-bins by a 3500 foot aerial tramway from No. 5 level.

Camp No. 1 is the main camp at the portal of No. 10, or 1000-foot level, the main haulage level of the New Idria. The crusher ore-bins are at the portal of this adit and transportation of ore is by 3-ton Edison Storage battery locomotives. All ore below No. 5 level is brought out through this haulage way. Two new levels have been opened up at 1100 and 1200 feet by a 2-compartment 55° incline shaft (winze) 200 feet from the vein on No. 10, or 1000-foot level. This shaft is 4000 feet from the portal and in the center of the mine. An 8″ by 10″ double-drum air-operated hoist is used. The lower levels of the New Idria are worked by overhead stoping with square-set timbering and back filling. The upper workings above No. 5 level are mined by quarrying as at the San Carlos.

An interesting new development at the upper workings (No. 3 level) of the New Idria is the installation of a Stevens-Adamson conveying system consisting of a 42″ belt on 700 foot centers, fed by a 42″ by 11′ apron feeder. This conveyor will handle 350 tons per hour. It extends from the portal of No. 3 adit to the hanging wall of the vein which here dips 45° into the mountain. The object of this installation is to facilitate the removal of all overburden from the vein and expose all the old workings from the 300-foot level to the surface. It is estimated that this will require the moving of from 1,500,000 to 2,000,000 tons of material, but when completed it will permit extensive quarrying of this section of the orebody.

At the present time about 40% of all ore going to the furnaces is from quarrying operations and 60% is mined underground. It is expected that within a year these percentages will be reversed and eventually even a greater portion of the ore will be removed by quarrying, particularly during favorable weather, at a considerable reduction in mining costs.

The ore reduction equipment now consists of four 60″ by 56′ oil-fired rotary kilns with tank condensing system arranged in two units which can be operated singly or together as desired. All reject from the furnaces is transported to the dump by a 1200-foot aerial tramway equipped with a 1⅔-ton bucket with automatic dump, carried on a 2″ steel cable.

No retorts of any kind are used. All dust, spray water, soot and other impurities drain to and are collected in a special tank fitted with a mechanical agitator which effects a separation of any mercury and it can be drawn off at the bottom. The remaining solids and water are passed through a series of three settling tanks. After settling this 'mud' is drawn from the last tank and spread out on a large steam-heated concrete floor. When thoroughly dry it is returned in small lots by elevator to furnace feed bins and again passes through the kilns. After reaching a certain ratio the amount of such material to be retreated does not appear to increase, as might be expected.

The New Idria Mine is completely equipped with machine shop, timber-framing shop, crushing plant with series of belt conveyors from outside storage bins to feed bins at reduction plant, and other labor-saving machinery. Underground stations in the mine, the various tramway terminals, and the surface plants are connected by an independent telephone system. The mine office also has long distance connections. Three separate camps are maintained with a foreman and crew at each that have their own boarding house and other facilities. The company's trucks transport the flasks of quicksilver from Idria direct to San Francisco, making the trip in one day. From San Francisco it is shipped by boat to New York and marketed there. About 150 men are employed.

Bibl: State Mineralogist's Reports I, p. 26; IV, pp. 336, 339; VIII, pp. 483–485; X, p. 515; XI, p. 373; XII, p. 365; XIII, p. 599; XIV, p. 228; XV, pp. 660–668. Bull. 27, pp. 9, 22, 125–129, 138–145, 213, 214, 234, 241, 245; Bull. 67, pp. 33, 35; Bull. 78, pp. 14, 17, 34, 93, 95, 109–115, 236, 248–250, 275–276, 329, 339–342. U. S. Geol. Survey Mon. XIII, pp. 64, 189, 215, 291–308, 465. Min. Res. 1882 to 1922. Min. Res. W. of Rocky Mts. 1868, p. 264; 1869, p. 10; 1870, p. 759; 1871, pp. 58, 528; 1872, p. 523; 1873, pp. 10, 497; 1874, pp. 28, 37; 1875, p. 13. Geol. Surv. of Cal., Geol. Vol. I, pp. 57–60; Vol. II, pp. 113–120. Trans. A.I.M.E, Vol. XXXIII, p. 484.

Niesen Group. The former owner of this property consisting of two claims in Sec. 31, T. 18 S., R. 12 E., and Sec. 36, T. 18 S., R. 11 E., John Niesen of Hernandez is deceased. The property is idle.

Bibl: State Mineralogist's Report XV, p. 669; Bull. 78, p. 120.

Stayton Mine. (See under Antimony.)

Tirado Group. Jose Tirado, Hernandez, owner. Consists of two claims in Sec. 18, T. 18 S., R. 12 E. A small production was made here in 1916 and 1917. Idle except for assessment work.

Bibl: State Mineralogist's Report XV, p. 670. Bull. 78, pp. 121–122.

Tirado and Shear Group. Owners, S. Tirado and Wm. Shear, Hernandez, California. This property consists of two claims on a new discovery made in 1925. The deposit is situated in the serpentine area south of Sampson Peak on a branch of Clear Creek 2½ miles in an air-line southwest of New Idria. There is reported to be 6 feet of good ore. One flask of quicksilver was recovered with a 2-pipe retort from an open cut on the outcrop, in doing assessment work. The deposit was not visited, but Mr. Tirado who has been long familiar with the properties in this district states that it is a very good looking prospect.

STONE INDUSTRY.

(CRUSHED ROCK, SAND AND GRAVEL.)

There is only one large operator in the county producing crushed rock and washed sand. Aside from this there has been some 'bank run' gravel and sand taken from gravel banks and from the bed of San Benito River, which has been used chiefly for filling and road work.

Berberich Gravel Pit comprises an area of six acres on the edge of town, owned by C. F. Berberich of Hollister. The deposit is a residual hill consisting almost entirely of gravel and clean sand with a few cobbles. There is scarcely any overburden. A depth of 110 feet of this material is said to have been shown by wells drilled into it indicating that the supply is almost unlimited. There is no screening or washing equipment and the material as dug is not suitable for important concrete work.

County Pits. The county has a gravel pit a few miles south of Hollister, from which road material has been obtained, and small screening plant above the road with loading chute for filling trucks at a point about half way to Emmet on the Idria road.

Granite Rock Company, A. R. Wilson, president and manager; A. J. Wilson, vice-president and engineer; C. E. Bloom, secretary; John E. Porter, sales manager. Office: Watsonville, California. D. W. Swearinger, plant superintendent, Logan, California.

The plant, also known as Logan Quarry, is located at Logan on the Coast Division of the Southern Pacific Railroad 93 miles south of San Francisco.

Granite forms the wall of Pajaro River Canyon at this point and rises about 300 feet above the level of the railroad tracks. The company owns 600 acres in all, about 100 acres of which can be worked. A face of granite has been opened up approximately one-half mile long but at present only about 1200 feet of it is being worked. The bench on which the steam shovels work and the quarry track is laid, is 100 feet vertically above the main line railroad tracks. From this working level the face rises 180 feet. There is an overburden consisting of approximately 35 feet of adobe, clay, sand and fossilized clam shells which is removed by hydraulicking. To do this water is pumped from Pajaro River by a 7″ by 10″ triplex Deane mine pump through two 4-inch pipe lines under 300-pounds pressure to the top of the deposit, a total elevation of over 300 feet. The water is delivered to a 3″ monitor and the material sluiced southeast down the mountain side to an impounding dam. It requires continuous hydraulicking to keep the overburden back from the slides caused by blasting. No drilling on top of the exposed rock is necessary. Air operated Sullivan drills are used to toe-hole or snake-hole the base of the quarry face to a depth of about 22 feet. These holes are sprung so they will contain a change of from 5 to 8 boxes of 40% powder. Several holes are shot simultaneously bringing down the whole face of the quarry in sizes that can be handled by the power shovels with some little additional blasting or bulldozing.

Equipment consists of one Model 50 Marion oil-fired steam shovel, one Model 20 Marion and one electric revolving shovel with $1\frac{3}{4}$-yard bucket. In addition there are fifty 4-yard western dump steel-lined cars and four 10″ by 16″ Porter oil-burning locomotives, 36″ gauge. At the storage yards there is one 12″ by 18″ Porter standard-gauge switching locomotive, one 30′ Ohio locomotive crane and 100-ton track scales.

The broken material is loaded in trains of 12 cars each for delivery to the crushing plant.

The crushing plant is unusual in that it consists of two parallel units practically alike called the No. 8 and No. $7\frac{1}{2}$ plants which may be operated as one or as distinct units. Both units are fed through long side-hill chutes lined with special steel T-bars, their lower ends having bar grizzlies 12′ by 30′ with 2″ spacing. Each chute will hold several trainloads of rock. Material passing through the grizzlies is removed by belt conveyors to a 48″ by 16″ screen from which rock $\frac{3}{8}$″ and over is recovered and the fines transferred to a waste bin on the track-loading level, or elevated to the quarry-floor waste bin. This material consists mainly of rotten weathered rock and was formerly given away but is now sold for special uses. It is called Base rock and is particularly suitable as a water bound macadam road material. Over 170,000 tons of this was produced in 1925.

Plant of Granite Rock Company at Logan, San Benito County. The quarry face shows above and to the left of the buildings.

The crushing equipment in the No. 8 unit consists of a No. 8 McCully gyratory, followed by a 48″ by 10′ scalping screen, two No. 4 and one No. 2 Telsmith regrinders, another 48″ by 10′ scalping screen, two electric Hum-mer screens and two 60″ by 20′ sizing screens.

The No. $7\frac{1}{2}$ unit has a No. $7\frac{1}{2}$ McCully gyratory followed by a 48″ by 10′ scalping screen, one No. 4 Telsmith reduction crusher in closed circuit, an electric Hum-mer screen and two 48″ by 16′ sizing screens.

A new regrinding plant is connected by a conveyor belt with the two units of the primary plant and can draw from any bunker in the two units. The conveyor belt discharges into a 250-ton feed bunker which discharges to three 6″ Allis-Chalmers McCully type regrinding crushers, the discharge of which passes to five Link-Belt shaking screens. The equipment permits the production of a large number of stock sizes. These include: 2½″; 2″; 1½″; 1″; ¾″-½″; ½″-⅜″; ⅜″-¼″; ¼″-⅛″; ⅛′-20 mesh; 20 mesh-40 mesh and ⅛″ to dust.

Beside crushed granite rock the company also produces washed sand. This is pumped from the bed of Pajaro river by a suction dredge to a 14,000-gallon tank and screened through a ⅜″ square-mesh revolving screen. The sand plant has a capacity of 6 cars in 8 hours. Operations at Logan quarry began in a small way in 1900. The capacity of the crushing plant is now 2000 tons in 8 hours and fifty men are employed.

The rock is a tough dark-colored basic granite, but the mass as a whole is quite thoroughly fractured as the San Andreas fault line passes through it. A blast may bring down anywhere from 500 to 50,000 tons depending on the condition of the bank. A large slide during the past year buried and completely wrecked one of the steam shovels.

Bibl: State Mineralogist's Report XV, p. 671. Rock Products, February 9, 1924.

STRONTIUM.

A vein of celestite (strontium sulphate) about three inches in thickness was cut years ago in some of the old workings at the Butts quicksilver mine near Pine Rock. A sample of this is in the possession of H. V. Underwood, of Hollister. It is the only known occurrence of strontium mineral in the county. The deposit is doubtless too small to have a commercial value.

VOLCANIC ASH.

H. V. Underwood, Hollister, California, reports the occurrence of a bed of white volcanic ash on Tres Pinos Creek, about 10 miles south of Paicines in the Emmet district. Undeveloped.

LOS ANGELES FIELD DIVISION.

W. Burling Tucker, Mining Engineer.

IMPERIAL COUNTY.

Introduction.

Imperial County formed part of San Diego County from the organization of the latter in 1850 to August, 1907, when it was created into a separate county by vote of the supervisors of San Diego County, under an act of the legislature giving them that power.

The principal industries of Imperial County are agriculture, stock raising and dairying. Its mineral resources are varied and extensive and the rapid and continued growth of the towns of Imperial Valley and the manufacturing industries of the Pacific Coast have led to the development of deposits of structural and industrial materials throughout the county.

Description.

Imperial County is bounded on the east by the State of Arizona, north by Riverside County, west by San Diego County and south by Mexico. Its area is 4089 square miles, with a population of 43.383 (1920 census). The county is served by two railroads, the Southern Pacific and the San Diego and Arizona. The transcontinental line of the Southern Pacific Railroad enters the county on the north near Durmid on the eastern shore of the Salton Sea and runs southeasterly through the county to Yuma, Arizona. From the main trunk line a branch from Niland runs through the Imperial Valley to El Centro and Calexico and continues on into Mexico, connecting Mexicali with Yuma. The San Diego and Arizona Railroad enters the county from the west, connecting San Diego with Imperial Valley at El Centro. Two main paved highways afford easy access to the county from the north. The highway between San Diego and El Centro forms part of the coast route from Los Angeles to Imperial Valley, Yuma and Phoenix. The other route from Los Angeles is over the Valley Boulevard by way of Beaumont and Banning to Brawley and El Centro. The Blythe-Glamis route to Yuma and Imperial Valley is one of the main desert roads, which enters the county from the northeast at Palo Verde and runs southwest to Glamis, from which point the road follows the railroad north to Niland.

Physiography.

The most important feature of Imperial County is the broad and nearly level expanse of the Colorado River Delta which separates the Gulf of California from the Salton Basin and is known as Imperial Valley. The Salton Sea region is one of the interesting topographical features of the county. Diagonally across the region, from southeast to northwest, it extends as a great trough whose lowest point is nearly 300 feet below sea level. On the west side of this deep trough rise the Peninsular Mountains whose culminating points are 10.000 feet above sea level. On the east side is a desert containing irregular ranges and undrained basins ranging in altitude from a few hundred feet to 5000 feet or more.

The eastern border of the territory is formed by the Colorado River whose waters flow through a low valley and finally spread out over a huge delta as they enter the Gulf of California.

The surface of the central portion of the Salton Basin is very even and nearly flat; about its borders are alluvial slopes. In a number of places rock masses protrude above the even surface of the basin as rocky islands project out of the sea. Such island-like features are formed by Borego, Superstition and Carrizo mountains, the Cargo Muchacho Mountains, Pilot Knob and a number of volcanic buttes 100 to 200 feet high south of Salton Sea.

The Sand Hills constitute an important feature of the physiography of Salton Basin. The sand hills east of Imperial Valley constitute the largest belt of dunes in this region and also one of the largest in the United States. They extend southeastward from the vicinity of Amos and terminate a few miles beyond the Mexican boundary, being about 40 miles in length and from two to six miles in width. The crests of some of the dunes rise in places 200 to 300 feet above the land on either side.

Another interesting feature of the Salton Basin is the old beach line which lies 40 to 50 feet above sea level and encircles Imperial Valley, the Salton Sea and part of Coachella Valley south of Indio.

Geology.

The most useful references on the geology of the region are Blake's original description of the Salton Basin,[1] Mendenhall's papers on Coachella Valley and Carrizo Creek,[2] Fairbank's report,[3] and U. S. Geol. Survey Water-Supply Paper No. 497, 'The Salton Sea Region, California,' by John S. Brown. In the following notes on the geology of Imperial County, excerpts are taken from the last-named paper:

According to most geologists who have worked in this region, the oldest rocks are probably of pre-Cambrian age. The pre-Cambrian rocks occur mainly in the desert mountains in the region between the Salton Basin and the Colorado River. They are commonly flanked by Tertiary or later sediments about the mountain borders and in large areas they are covered or intruded by Tertiary volcanic rocks. The rocks that can most certainly be referred to as the oldest series consist of granite and granitic gneiss. In this series probably belong the granite and schist that compose most of the Cargo Muchacho Range and the granite, slate and schist that form the basements of the Picacho Hills and the eastern part of the Chocolate Mountains. On the western border of the desert in Carrizo Mountain, and on the top of Fish Mountain in the Carrizo Creek region, are beds of marble and some schist and sandstone which have been referred by Mendenhall and Fairbanks to the Paleozoic, with suggestion that they may be Carboniferous. Marble, schist and gneiss of undetermined age in the Santa Rosa Mountains may belong to the same series of rocks as the Carrizo Mountain district.

---

[1] Blake, W. P., Pacific Railroad Reports, Vol. V, 1853.

[2] Mendenhall, W. C., Ground waters of the Indio Region, Calif., with a sketch of the Colorado Desert: U. S. Geol. Surv., Water Supply Paper No. 225, 1909.

[3] Fairbanks, Harold W., Geology of San Diego, Orange and San Bernardino Counties: State Mineralogist Report XI, pp. 76–120, 1892.

Tertiary Sedimentary Deposits.

Sedimentary beds, believed to be of Tertiary age, occupy extensive areas along the southwest and northeast sides of the Salton Basin and presumably underlie practically the entire basin. The largest and best-known exposures southwest of Salton Sea are in Carrizo Creek Valley, around Yuha Well, south of the Santa Rosa Mountains and northeast of Superstition Mountain and Borego Mountain, and on the north side of Fish Mountain. The Tertiary beds consist of soft, poorly consolidated conglomerates, sand and clay containing in places a large amount of gypsum and some other saline materials. Part of the Tertiary beds in the region are marine and part terrestrial. Marine beds cover large areas in the Carrizo Creek region where they contain abundant marine fauna and are represented around Carrizo Mountain and north of Fish Mountain by chemical deposits such as gypsum and strontianite which were evidently deposited in water.

Tertiary and Quaternary Volcanic Rocks.

The volcanic rocks of this area are probably mostly Tertiary; some of them are Quaternary. They occur as flows interbedded with sedimentary beds in the Carrizo region, around Superstition Mountain, and in Iris Pass. The lavas are most prominent in the Chocolate and Palo Verde mountains. The Palo Verde Mountains are entirely volcanic, being chiefly a mass of andesitic or rhyolitic flows. The Chocolate Mountains, from one end to the other, exhibit a great mixture of andesitic and rhyolitic flows with possibly syenite and trachyte in the west end.

The only volcanic material of unquestionably Quaternary age in this region is found in the vicinity of the mud volcanoes southeast of Salton Sea where three or four small buttes of black obsidian protrude through the Quaternary silt.

Quaternary Deposits.

The Quaternary deposits immediately underlie nearly all the lowlands and have the largest areal extent of all the rock formations. They underlie the larger part of the Salton Basin and practically all of the Colorado River Valley. The valley fill consists of sand, gravel and clay washed down from the hills and mountains.

Mineral Resources.

The last general report on the mines and mineral resources of Imperial County appeared in Report XIV of the State Mineralogist (1913–1914). The writer of the present article spent from October 15, 1925, to January 15, 1926, on a survey of the county in an endeavor to collect up-to-date information on mining activities and mineral resources.

Appreciation is here expressed for the courteous treatment and cooperation of operators, owners and the Chambers of Commerce throughout the county. Acknowledgments are especially due C. F. Stahl of the Pacific Portland Cement Company; Frederick A. Ballin, Columbia Cement Company; P. J. Kane, of Ogilby, for their cooperation and for the valuable information which they furnished.

During 1924 Imperial County produced seven mineral substances having a total value of $139,908 as compared with the 1923 output worth $264,733. It ranks as the forty-sixth county in the state's mineral production. Imperial County contains deposits of clay, copper, cyanite, gold, gems, gypsum, lead, manganese, marble, mineral paint, pumice, salt, silver, sodium, strontium, sulphur and talc, largely undeveloped. The attached table gives its complete recorded output and value of the mineral production from 1907 to and including 1924.

IMPERIAL COUNTY, 1907-1924.

Year	Brick		Gold, value	Silver, value	Miscellaneous stone, value	Miscellaneous and unapportioned		
	M	Value				Amount	Value	Substance
1907	1,000	$10,000						
1908	2,225	22,250	$5,848	$123		375 lbs.	$51	Copper.
1909	2,000	20,000	59,705	524				
1910	1,680	10,078	[2]87,341	[2]237				
1911	1,200	7,000	[2]97,855	[2]189				
1912	3,250	20,000			$10,000			
1913	5,500	44,000	31,700	94	12,000	750 cu. ft.	7,260	Marble.
1914	4,900	29,400	210,428	8,961		13,081 lbs.	1,730	Copper.
1915	2,958	17,916	14,369	42	40,095	65 lbs. 	11 5,000	Copper. Other minerals
1916	[3]		23,338	155	34,834		47,006	Brick, copper, lead, pumice, strontium.
1917	and tile	19,260	919	5	65,660	1,907 tons 	38,140 5,416	Manganese. Copper, potash, pumice.
1918	and tile	11,670	247	1,248	34,787	1,241 tons 	46,900 14,840	Manganese. Copper, lead, pumice.
1919	[3]			8,607	63,900		67,936	Brick, lead, pumice, salt.
1920	[3]			2,183	127,412	624 tons 	16,500 23,787	Pumice. Other minerals.
1921	654	6,363	537	920	171,173		3,825	Other minerals.
1922			350	18,024	154,560		15,805	Brick, gypsum, lead, marble, pumice.
1923					101,833		162,900	Brick, gold, gypsum, pumice, silver, soda (salt cake).
1924			258	1	78,032		61,617	Brick, gems (dumortierite), gypsum, pumice.
Totals		[3]$217,937	$532,895	$41,313	$894,286		$518,734	

[1] Imperial County was created August, 1907, from a part of San Diego County.
[2] Includes production of San Diego County.
[3] See under 'Unapportioned'.

METALS.

COPPER.

The occurrence of copper ores in this county is limited to the Picacho and Paymaster districts, and the Fish Mountains. In the former district surface stains of copper are widely disseminated through a considerable area three miles southeast of Picacho. It is reported that some drilling was done here in the past but the results were not encouraging. A number of claims have been located in this area, which are held by annual assessment work.

In the Paymaster district, the chief mineralization noted is in Secs. 23 and 26, T. 12 S., R. 20 E., S. B. B. & M., 16 miles east of Glamis. The oxides and carbonates of copper occur along shear zones in schists and along fractures in the monzonite and in one place the occurrence of copper sulphides was noted, finely disseminated in the monzonite. A number of claims have been located in this area and considerable surface prospecting has been done along the highly mineralized zones. On the west slope of Fish Mountains copper occurs as copper oxides and carbonates.

Cambell Group of Claims are located on the west slope of Fish Mountains, 15 miles northwest of Coyote Wells. The ore occurs as oxides and carbonates. Owners, George Cambell and associates of Seely.

Cave Man Group of Claims comprises four claims; Cave Man, Dixie Queen, Mary Louise and P. J. K., located in Sec. 26, T. 12 S., R. 20 E., S. B. B. & M., 16 miles east of Glamis, in the Paymaster mining district. E. B. Dykes, 861 West Tenth Street, Riverside, owner. The principal development work has been done on the Cave Man claim.

The formation is schist, quartzite and monzonite. The ore occurs along the contact of schist and quartzite and strikes N. 30° W. In the vicinity of this contact for a distance of 20 feet the rock is mineralized with malachite and azurite. Samples taken from the workings are reported to assay from 5 to 13% copper, with gold and silver values. Developments consist of open-cuts and a short tunnel driven northeast. Two men employed.

Picacho Copper Deposit. This deposit is located two miles southeast of the village of Picacho and about 3 miles east of Picacho Peak.

The schists in this area strike northwest and dip 50° southwest. Surface stains of copper are widely disseminated throughout this belt of schist. The principal mineralization appears for a mile in length and about one-quarter of a mile in width. About 160 acres are held by location by different individuals of Picacho and Yuma, Arizona. The mineralization is along shear zones in the schist that strike northwest. The schist is heavily stained with malachite. On the west side of a small butte considerable development has been done, there being five shafts having depths of 50 to 75 feet and a large number of trenches and open cuts exposing considerable ore. A number of years ago three holes were put down at different points on the deposit but it is said that the results were not encouraging. On the north end of the deposit are a number of siliceous outcrops that are mineralized with chalcopyrite.

Volunteer Group of Claims comprises eight claims located in Secs. 23 and 26, T. 12 S., R. 20 E., S. B. B. & M., 16 miles east of Glamis, adjoining the Cave Man Group on the northwest, in the Paymaster mining district. Owner, P. J. Kane, of Glamis.

These claims were located in 1917 and since that date considerable development has been done, consisting of prospect shafts and open-cuts. The formation is monzonite and schist. The chief mineralization occurs along fractures in the monzonite which strike north and dip 80° east. The fractures are heavily mineralized with malachite and azurite and in one prospect hole the monzonite shows copper sulphides disseminated through the rock.

The principal development work has been confined to a small rounded hill near the camp. On the south slope of this hill several shafts have been sunk to depths of eight to ten feet, all of which have developed some ore. The main working shaft has been sunk to a depth of 70 feet, on a fracture in the monzonite which strikes north and dips 70° east. The fracture is mineralized with azurite and malachite over a width of six feet. Samples taken from these workings are reported to assay from 5% to 10% copper and $5 in gold and silver. Equipment consists of a gasoline engine, crusher and small leaching plant. Two men are employed.

Workings on Volunteer Group of Claims in Chocolate Mountains, Imperial County.

GOLD.

Gold is widely scattered over the desert region of the county and has probably been mined to some extent in every mountain range. It occurs as placer gold; in veins of quartz in granitic rocks and in mineralized zones in schist. The placers have usually been either too low-grade or too far from water to be profitably worked. The gold deposits that have been productive in the past occur in the southeastern corner of the county, in the mountain ranges between the line of the Southern Pacific Railroad and the Colorado River.

The principal producing districts are located in the Cargo Muchacho Range which trends northwest and in the Picacho range of mountains which also has a northwest trend along the Colorado River.

The Cargo Muchacho Range is made up of metamorphic gneiss and schist cut by pegmatite dikes and lies three to four miles northeast of the line of the Southern Pacific Railroad, its southeastern extremity being nine miles from Yuma. In the northern section of this range, sometimes called the Hedges Mountains, of which the summit measures 2225 feet, is the Hedges district and in the southern section is the Cargo Muchacho district, the highest peak having an altitude of 2130 feet. Many auriferous veins have been found along the ridges of this range and in all the gulches of the range and washes leading from them, placer gold has been abundant.

The Picacho range of mountains, of which the chief summit is El Picacho, attains a height of 1945 feet. The range is made up of volcanic lavas, tuffs and conglomerates. The volcanics are underlain by metamorphic schists and gneisses which contain the chief gold deposits and are probably of the same age as those of the Cargo Muchacho Range. Mining has been carried on in the Picacho district almost continuously since 1857 but since 1910 there has been no great activity and very little production.

In the Cargo Muchacho Range mining has been done on a large scale at various times since 1879. The different productive mines were under operation more or less continuously until 1915 when operations came to a standstill on account of the World War and practically all mill and other equipment, including pipe lines from the Colorado River, were removed from the American Girl and other mines of the Hedges district and sold for junk. At present writing nothing is being done in these districts except development work on the various claims held by their owners.

Dry Placers.

The dry placers are for the most part located in the eastern part of the county, chiefly in the Colorado desert region. These are probably the earliest known sources of gold in the state, having been worked in the early days by the Mexicans and Indians. The most productive deposits are known as the Mesquite, Picacho and Pot Holes or Laguna. The gold in these districts came from the quartz stringers in the schists and slates of the Cargo Muchacho and Chocolate ranges of mountains, being brought down and concentrated in the different gulches and washes by erosion. The Pot Holes district, from which a reported production of $2,000,000 has been taken out, is near Yuma. It is stated that as many as 400 or 500 Mexicans were working with hand-washing machines for a period of several years. Much gold is reported to have been taken from the placer workings at Picacho and Mesquite in the early days. It is stated that the gravel of the Picacho basin has an average value of 35 cents per yard. A number of attempts have been made to work these gravels by dry placer machines but with poor success.

Mines.

American Girl. This property is located five miles northeast of Ogilby, in Sec. 17, T. 15 S., R. 21 E., S. B. B. & M., in the Cargo Muchacho Range of mountains. Elevation, 700 feet. Owner, Imperial Reduction Company; R. Schiffman, president; Mac D. Snowball, secretary; office, Pasadena.

The mine was discovered in 1877 and worked until 1915 when operations were suspended and all equipment removed from the property. The ore is quartzose vein matter and silicified schist, carrying iron pyrites which contain gold occurring in granite gneiss and schist. The vein worked had a maximum width of 40 feet. It strikes northwest and dips 35° southwest. Development consists of an incline shaft sunk on the vein to a depth of 1000 feet, with levels at every 100 feet. Idle.

Bibl: State Mineralogist's Reports XIII, p. 331; XIV, pp. 728–729.

Blossom Mine comprises three claims located in the Cargo Muchacho Mountains, at an elevation of 400 feet, four miles east of Ogilby, a station on the Southern Pacific Railroad. Developments consist of an incline shaft 280 feet deep, located one mile southwest of the American Girl. The ore on the dump is similar to the American Girl. Owner, John McEwen of Ogilby. Idle.

Bibl: State Mineralogist's Reports XII, p. 238; XIII, p. 332; XIV, p. 729.

Butterfly Group of Mines comprises seven claims, located east of the American Girl and four miles northeast of Ogilby, a station on the Southern Pacific Railroad, in the Cargo Muchacho district. Elevation, 800 feet. Owner, S. C. Samson, of Ogilby. The vein runs northwest and dips southeast. An incline shaft has been sunk to a depth of 325 feet on the vein. Idle.

Cargo Muchacho Mine is four miles east of Ogilby, a station on the Southern Pacific Railroad, about 1½ miles southeast of the Blossom Mine in the Cargo Muchacho Mountains. The vein occurs in hornblende schist and is from two to eight feet in width. Its strike is north and the dip from 45° to 50° east. Developments consist of two shafts, one being 500 feet deep, the other 200 feet. Idle.

Bibl: State Mineralogist's Reports VI, p. 81; XI, p. 385; XII, p. 239; XIII, p. 334; XIV, p. 729.

Desert King Mine comprises four claims known as Desert King, Desert Queen, Highland Chief and Red Hawk, and is located in Sec. 12, T. 15 S., R. 20 E., S. B. B. & M., in the Hedges mining district, in the Cargo Muchacho Mountains, five miles north of Ogilby, a station on the Southern Pacific Railroad. Owners, M. B. Patton, C. S. Walker and B. F. Harrison, of Glendale, California.

The main vein, which strikes N. 60° W and dips 55° SW., has a width of from three to five feet. It occurs in a micaceous quartz schist which is cut in all directions by pegmatite dikes that vary in width from a few inches to several feet. The ore is a quartzose schist, stained with copper and is said to average $15 per ton in gold.

The development on this vein consists of a shaft sunk on the vein to a depth of 150 feet. At a depth of 75 feet a drift has been driven east 100 feet and also west 125 feet. From the bottom of this shaft is a drift east 50 feet and west 50 feet. A cross-cut tunnel is driven north 75 feet and this connects with the shaft on the 75-foot level. About 300 feet west of these workings, at a lower elevation, a cross-cut tunnel has been driven N. 60° E. for 300 feet. At 100 feet from the portal of this tunnel a small ore shoot is cut which was stoped to the surface. At this point a drift, which evidently is not on the vein, has been driven north 200 feet and there is also a drift east 100 feet but no ore has been developed. Ore stoped is said to average $5 to $20 per ton.

Northwest of these workings, on the opposite slope of the ridge, considerable prospecting has been done on a parallel system of veins. On one of these veins is an incline shaft 30 feet deep and also a tunnel 30 feet in length. The vein is 12 inches to three feet wide, strikes northeast and dips 35° southeast. A 10-stamp mill was formerly on the property but this was removed in 1915. The only equipment consists of a head frame, ore bins and framework of the mill. Two men are employed on development work.

Duncan Mine. It comprises five claims located 1½ miles northwest of Pot Holes or the Laguna Dam. Owner, W. H. Trenchard, of Laguna. The vein, which has a width of 7 feet, occurs in granitic gneiss. Ore milled from the vein is said to have plated $14 per ton. Development consists of an incline shaft sunk on the vein to a depth of 200 feet. Idle.

El Lucero Group of Claims contains five, known as El Lucero, Cuidadela, La Fortuga No. 1 and No. 2, and Missing Link, located 17 miles northwest of Yuma and about 4 miles from the Colorado River in the Picacho mining district. Elevation 450 feet. Owners, Abel Ochoa and Philip Hess, of Yuma, Arizona.

The veins, which have widths of 2 to 4 feet, occur in a granitic gneiss. The veins strike N. 20° W. and dip 40° west. The principal development has been on El Lucero claim. Two incline shafts have been sunk to a depth of 30 feet. The quartz vein is oxidized, being stained with iron oxides and some copper stain. Ore shoot developed is 30 feet long with an average width of two feet. On La Fortuga claim, about 700 feet north of these workings, a tunnel is being driven south to intersect the vein at a lower elevation. On the Missing Link Claim, which is located one-half mile north of El Lucero workings, considerable surface prospecting has been done on a parallel vein. One man employed.

Erma Mine, formerly owned by the Erma Mining Company, comprises twelve claims located in the vicinity of the Mesquite Placer, in Sec. 21, T. 13 S., R. 19 E., S. B. B. and M., about 7 miles northeast of Glamis. Elevation 950 feet. The gold occurs in pockets in some quartz veins in the schists. These veins are about 3 feet wide. Development consists of a number of shafts from 50 to 100 feet deep. Claims at present held under names of different locators.

Gold Basin Mine comprises four claims located in Sec. 3, T. 12 S., R. 20 E., S. B. B. and M., 18 miles northeast of Ogilby, a station on the Southern Pacific Railroad and 1½ miles east of the Glamis-Palo Verde road, in the Chocolate Mountains. Owner, C. A. Gibson of Brawley. The mine was discovered by Thomas Dunn in 1915 and worked in 1917, when a rich lens of ore that is reported to have produced $500 in gold was encountered.

A series of parallel veins of quartz 12 to 18 inches in width occur in diorite. These veins strike northeast and dip from 60° to 70° to the southeast. A number of shallow shafts have been sunk on the different veins. The deepest of these is 100 feet. North of this shaft is also a tunnel which has been driven south 50 feet to intersect a quartzite dike that strikes east. The quartz is copper-stained and is said to carry values in gold from $25 to $50 per ton. Equipment consists of cars, track and arastra. Only annual assessment work is being done on the property.

View of Cargo Muchacho Range of Mountains, Tumco District.
Ogilby, Imperial County.

Golden Cross Group of Mines. This group of mines is located on the western slope of the Cargo Muchacho Range, in Sec. 1 and 12, T. 15 S., R. 20 E., S. B. B. and M., and in Sec. 6 and 7, T. 15 S., R. 21 E., S. B. B. and M., in the Hedges mining district 4½ miles north of Ogilby, a station on the Southern Pacific Railroad. Elevation 700 feet. The property originally comprised twenty claims but the principal workings were on the Golden Cross, Golden Crown, and Queen claims.

The mines were operated from 1910 to 1914 by the United Mines Company of Los Angeles and the company changed the name of the camp to Tumco. During 1916 the mines were operated by the Queen Mining Company of Ogilby when 30 stamps of the mill were run, crushing 50 tons per 24 hours.

The properties were equipped with hoisting and compressor plants, also 100-stamp mill and cyanide plant. This equipment, including pumping plant and pipe line from the Colorado River, was removed from the property in 1917 and sold as junk. At the time the district was visited by the writer, the camp was practically abandoned. These properties are held by location as the *Good Luck Group*, comprising six claims, by M. B. Patton, C. S. Walker and B. F. Harrison, of South Pasadena, California.

The formation in the vicinity of these mines is a micaceous quartz schist, in part feldspathic, which is cut in all possible directions by pegmatite dikes, varying from a few inches to several feet in width. The orebodies are in quartzose schist or gneiss and the mineralization parallels the stratification in certain layers of the schist. The silicified hornblende schist carrying gold, dips about 30 to 35 degrees southeast with a strike N. 35° E. The veins are from 2 to 25 feet in width. The ore shoots mined varied in width from 15 to 25 feet. The country is extensively faulted and at least two systems of faults exist. One of these, a major system, trends nearly northeast and the minor system has a trend nearly east.

There are three incline shafts and glory holes known as Golden Queen, Golden Crown and Golden Cross. The Golden Cross is sunk on an incline of 37° to a depth of 1200 feet. The Golden Queen shaft is sunk on an incline of 35° to a depth of 1000 feet and the Golden Crown to a depth of 1100 feet. The Golden Crown and Golden Cross shafts are on the same vein system, while the Golden Queen is on a monoclinal fault block north of that which contains the other two and it is probable that the two ore-bearing strata were once continuous, faulting in the major system having displaced and cut off the Golden Queen block from that containing the others.

The total underground workings are said to comprise over eight miles of drifts. Levels were driven from the different shafts every 100 feet. Considerable area of the mineralized schists was mined by the glory hole method above the three shafts. It is reported that the ore mined from the glory holes had values of from $1.50 to $2.50 per ton, while that mined underground ran from $4 to $8 per ton. The production from this group of mines amounted to $2,000,000.

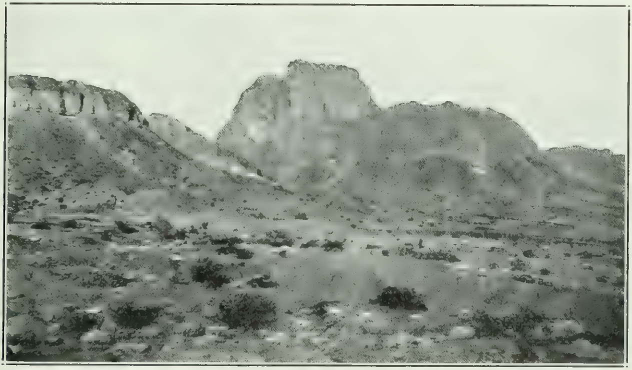
Bibl: State Mineralogist's Reports XII, p. 240; XIII, p. 337; XIV, pp. 726–728.

Mendeville Group of Claims. These claims are located one mile east of the Picacho Basin Mine in the Picacho mining district. Elevation 560 feet. Holdings comprise two claims, owned by J. Mendeville, of Yuma. Under option to L. M. Tobin, of Yuma, Arizona. The orebody is in a quartzose schist or gneiss and a silicified country rock which contains gold. The vein of silicified schist is 50 feet wide and strikes north with a dip of 60° west. The orebody has been developed by an incline shaft to a depth of 75 feet and a crosscut east 50 feet and drift south along contact of andesite and schist 25 feet. A vertical shaft about 50 feet deep connects with this south drift. It is stated that a sample taken from the full length of the cross-cut had a value of $7 per ton in gold. Idle.

Mesquite Placer is located in Sec. 21, T. 13 S., R. 19 E., S. B. B. and M., about 7 miles by road northeast of Glamis. Elevation 950 feet. The gravels lie along the washes of the present water courses from the Chocolate Mountains which drain into the bed of a dry lake against the sand hills, ten miles to the south. The placer gravels are in places fifteen feet deep but are not continuous and probably the average depth would not be over six feet. During the early work on these placers, water was packed from Glamis and the gravels panned and run through rockers. Some dry placering has also been done. Although the deposits are not continuous but cut through by arroyos, they vary in width up to one-half mile and extend for about two miles along the flank of the Chocolate Mountains. Much gold is reported to have been taken from these workings in the early days and probably considerable areas remain which could be worked if water could be secured.

Bibl: State Mineralogist's Report XIV, p. 731.

Ogilby Group of Mines comprises seven claims located in the Cargo Muchacho Mountains, four miles northeast of Ogilby, adjoining the American Girl Mine on the west. Elevation 700 feet. Owners, S. C. Samson and Thomas Johnson, of Ogilby.



Dry placers and view of Picacho Peak. Picacho Basin, Imperial County.

The ore occurrence is similar to that on the American Girl Mine. The orebodies are in a quartzose schist or gneiss, carrying iron pyrites which contain gold.

Developments consist of six shafts, the deepest being 500 feet. The veins strike northwest and dip 35° to 40° to the southwest. The present development is confined to sinking a new incline shaft. A 5-ton Ellis ball mill is being installed. Two men are employed.

Padre and Madre Mine is in the Cargo Muchacho district, four miles east of Ogilby, a station on the Southern Pacific Railroad and adjoins the Blossom Mine on the southeast. Owner, Mrs. S. B. Wright, of San Bernardino.

Bibl: State Mineralogist's Reports XII, p. 242; XIII, p. 343.

Pasadena and South Extension Mine comprises two claims located in Sec. 20, T. 15 S., R. 21 E., S. B. B. and M., in the Cargo Muchacho district, four miles north of Ogilby, a station on the Southern Pacific Railroad. Developments consist of a shaft 100 feet deep. Owner, William Borthwich and associates of Ogilby, California. Idle.

Bibl: State Mineralogist's Reports XI, p. 386; XII, p. 242; XIII, p. 343; XIV, p. 729.

Peg Leg Mine. It is located on the eastern slope of the Chocolate Mountains, about 15 miles west of Niland.

The vein has a width of two feet and strikes N. 30° W., dip vertical. The country rock is granite. The development work consists of two shafts sunk on the vein, the north shaft being 150 feet deep, and 300 feet south of which is another shaft 75 feet deep. The vein quartz is iron stained. It is also stained with copper. Idle.

Picacho Basin Mine (Placer). It is 25 miles north of Yuma and about 5 miles south of Picacho P. O. The basin consists of low, rolling hills covered in part by washed gravel and detritus from the neighboring hills. These superficial deposits are gold-bearing and have been worked by Mexicans and Indians for years, and recently by dry washing machines. The gravels have been worked along the arroyo, between the Picacho Basin mine and the village and the ground is now owned by the Ridgeway Estate, of Philadelphia, Pennsylvania. It is reported that the gold-bearing gravels have an average value of 35 cents per cubic yard.

The property is at present under option to L. M. Tobin, of Yuma, Arizona.

Picacho Basin Mine (Quartz). It is located 25 miles north of Yuma, and about 5 miles south of the Colorado River and the village of Picacho.

The property comprises 36 claims located in T. 13 and 14 S., R. 22 and 23 E., S. B. B. and M. Elevation 580 feet. Owner, Ridgeway Estate, of Philadelphia. Agent, F. F. Rielly, of Picacho. Under option to L. M. Tobin, of Yuma, Arizona.

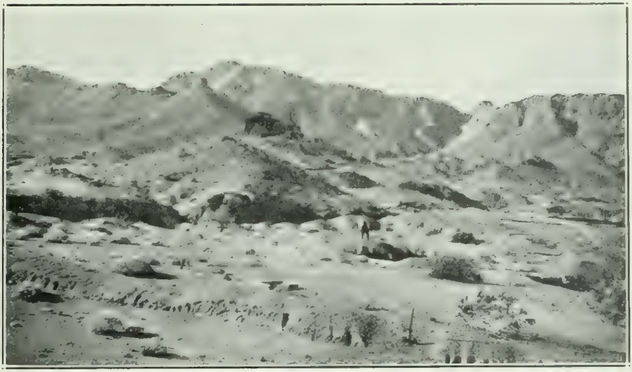
The property was operated by the Picacho Basin Mining Company from 1904 to September, 1910, when operations were suspended. The production is reported to have been about $2,000,000.

The rock formations are micaceous and hornblende schists, diorite and a few intrusive dikes, mostly granitic. On the east, south and west of the basin are rugged hills of rhyolite, rhyolite tuff and andesitic rocks, the most prominent mass being the rugged ridge called Picacho Peak. This peak has an elevation of 1500 feet above the Colorado River.

The orebody, which was a lode, occurred in lenses in schist, dipping at an angle of 45° to the southwest and the general strike of these lenses is N. 40° W. Three parallel and distinct lenses were developed on the property. The first lens developed was on the Pennsylvania claim. This shoot of ore was 250 feet long and 150 feet wide. It was first developed and worked through two shafts to a depth of 250 feet, then the ore was mined by the glory hole method. The glory hole is about 250 feet in length, with a width of 160 feet. The ore from these workings was transported by rail to a mill on the Colorado River, a distance of five miles from the mine. In 1908, this mill was moved to the mine and installed at the Diablo shaft. It had a capacity of 400 tons. The Diablo shaft is located 750 feet southwest of the glory hole and the shaft is sunk on an incline of 50° to a depth of 450 feet. The lens of ore worked was 250 feet long and 160 feet wide. Levels were driven from the shaft every 50 feet. Most of the stoping on the shoot is northwest of the shaft. A large tonnage of ore was milled which is said to have had an average value of $3 per ton. At the present writing the mill and buildings are being wrecked by Tobin and Brown of Yuma and the lumber is being hauled to Yuma for sale.

Bibl: State Mineralogist's Reports XII, pp. 237–243; XIII, pp. 331–346; XIV, pp. 729–730.

Potholes (Placer). These dry placers are located 10 miles northeast of Yuma and several miles west of Laguna Dam. Elevation 150 feet.



Picacho Basin Mine, showing Diablo shaft and dry placer workings. Picacho, Imperial County.

The gold-bearing gravels of this region were extensively worked in the early days by Indians and Mexicans and the placers have produced considerable gold.

Bibl: State Mineralogist's Reports XII, p. 242; XIII, p. 344.

Senator Mine. This mine comprises one patented claim located in T. 15 S., R. 28 E., S. B. B. and M., five miles north of Potholes and about one-half mile from the Colorado River. Owners, W. W. H. Williams and O. B. DeWitt, of San Bernardino.

A quartz vein 8 feet wide occurs in the schist. It strikes northwest and dips 70° southwest. Development consists of an incline shaft sunk on the vein to a depth of 300 feet. Drifts have been run on the vein on the 100, 180 and 270-foot levels. A small amount of stoping was done on the 100 and 180-foot levels. Idle.

IRON.

A deposit of iron oxide, reported to carry 50 to 60 per cent iron, occurs about three miles northeast of Amos Station on the western slope of the Chocolate Mountains.

Dan Simpson of Niland, J. H. Churchill, and Edgar Wear of Los Angeles, have recently located a group of claims in Sec. 33, T. 9 S., R. 16 E., S. B. B. and M., on a deposit of magnetite that occurs in the Chocolate Mountains, 17 miles northeast of Niland.

LEAD AND SILVER.

Lead-silver ores occur in the county in the Paymaster district on the eastern slope of the Chocolate Mountains, 17 miles northeast of Glamis, a station on the Southern Pacific Railroad. Lead carbonate and galena also occur in the Picacho district, the principal deposit being located five miles east of Picacho, and one mile south of the Colorado River. The most productive mine was the Paymaster which was worked from 1867 to 1880. Since the latter date, spasmodic attempts have been made to work the property, and in recent years the tailings from previous mill operations were treated by the cyanide process.

Mines.

Homestake Mine comprises three claims located one mile northeast of Paymaster Mine, and two miles west of Midway Well, in the Poorman's mining district. Elevation 750 feet. Owners, Vaughn Langlin and V. Bloomer, of Brawley.

The vein has a width of 6 feet, strikes N. 60° E., and dips 70° N. The formation is granitic gneiss and monzonite. The ore is lead carbonate and galena, carrying values in silver. Developments consist of a shaft sunk on the vein to a depth of 75 feet, a crosscut tunnel 25 feet in length and some shallow opencuts. Idle.

The Mayflower Mine comprises six claims located in Sec. 11, T. 14 S., R. 22 E., S. B. B. and M., five miles east of Picacho and one mile south of the Colorado River.

The ore is lead carbonate and galena which occurs in small veins and pockets in the schists. It is reported that some of the ore mined carried as high as 90 oz. silver per ton.

Developments consist of opencuts, short tunnel and shafts 50 to 90 feet in depth. Owner, W. H. Trenchard, of Laguna.

Paymaster Mine comprises thirteen claims located as the *Flagpole Group* but known as Paymaster Group of mines, situated in Secs. 19 and 30, T. 11 S., R. 20 E., and in Sec. 24 and 25, T. 11 S., R. 19 E., S. B. B. and M., on the eastern slope of the Chocolate Mountains, 25 miles by road northeast of Glamis, a station on the Southern Pacific Railroad, and three miles west of Midway Well. Elevation 800 feet. Owners, Judge Guy P. Hocker and J. C. Frank, 827 Stock Exchange Building, Los Angeles.

The mineralization occurs along a vein that is on the contact of granitic gneiss and monzonite which strikes N. 45° E., and dips 70° NW. A series of parallel rhyolitic porphyry dikes that strike south, intersect the Paymaster vein 500 feet east of the shaft. The vein can be traced on the surface for a distance of over 4000 feet. The ore is lead carbonate, carrying silver values. Two ore shoots were developed by means of shafts. The Paymaster shaft was sunk to a depth of 385 feet on a 70° incline and ore stoped from 200-foot level to the surface for a distance of about 250 feet in length. Width of ore mined was from 8 to 15 feet. Two veins were worked on the Paymaster claim, known as footwall and hanging-wall veins. Levels were driven every 100 feet on the vein, with crosscuts run to footwall vein on each level. On the 300-foot level, northeast of the shaft, a winze has been sunk to a depth of 85 feet on the vein.

About 1500 feet to the east of the Paymaster workings is the President shaft and underground workings. This shaft was sunk to a depth of 425 feet on the footwall side of the vein and about in the middle of the ore shoot. The ore was stoped from about the 200-foot level to the surface, for a distance of 250 feet in length on the vein, the width stoped being from 15 to 35 feet between walls. Levels were driven from the shaft every 50 feet below the 200-foot level. Most of the stopes are east of the shaft, and only the hanging-wall section of the vein was worked on the 300 and 400-foot levels. The vein has a maximum width of 35 feet and shows streaks of galena in the drifts on these levels. From a study made of the stopes, it appears that the orebody worked from the surface ended at the 150-foot level; then another lens of ore was worked from the 200-foot level to probably the 350-foot level. It is reported that the ore milled from the President workings carried 20 oz. in silver and from 7% to 10% lead.

Paymaster Mine, showing view of Paymaster shaft. Chocolate Mountains, Imperial County.

About 1800 feet east of the President workings are the Hazel workings. Here two shafts have been sunk on the vein to depths of 50 and 100 feet. The vein exposed in these workings is 15 feet wide. The ore is lead carbonate and galena, carrying small values in silver. It is said that samples taken from drifts on the vein carried 6 oz. silver and 10% lead.

The owners of the property also own 40 acres of patented land located in Sec. 15, T. 11 S., R. 20 E., on which is located a well and pumping plant with a 2-inch pipe line 3½ miles in length running from the well to the mine. The pumping equipment consists of gas engine, Gould Triplex pump and storage tank.

The Paymaster Mine was first located in 1867 and about 1870 a 10-stamp mill was installed on the property and operated until 1875. This mill probably treated 30,000 to 40,000 tons of ore from the Paymaster and President workings. It is reported that at one time there were about 20,000 tons of tailings on the property but a good proportion was washed away by cloudbursts and there are now about 6000 to 8000 tons, reported to assay 6 to 8 oz. in silver.

From 1880 to 1916 this property was located by a number of different parties but no production was made during this period. In 1916 the property was acquired by the Anaheim Exploration and Development Company; C. E. Holcomb, of Anaheim, California, president. This company installed a concentration plant at Midway Well and attempted to treat the ore from the Hazel workings. In 1918 the property was acquired by Judge Guy P. Hocker and J. C. Frank, of Los Angeles, who are the present owners.

In 1923 a cyanide plant was installed and 8000 tons of tailings, said to assay 6 to 8 oz. in silver, were treated, recovering $50,000 in silver. Idle.

MANGANESE.

Commercial deposits of manganese ore occur in the Paymaster district, in an outlying spur from the southeastern part of the Chocolate Mountains and in the Palo Verde district, in the Palo Verde range of mountains.

The Palo Verde Mountains are a mass of deeply-eroded volcanic flows extending from the vicinity of the Colorado River, eight miles south of Palo Verde, northwestward for about 20 miles. The manganese deposits occur in a number of short veins or shear zones that cut the basic lava flows.

In the Chocolate Mountains the veins containing the manganese deposits cut lavas of Tertiary age, and a conglomerate that is probably Quaternary.

The manganese ore consists of the oxides, psilomelane, pyrolusite and manganite. Psilomelane is the dominant oxide in all these deposits.

The deposits in the Chocolate Mountains are accessible from Glamis, on the Southern Pacific Railroad, by wagon road 32 miles long, and the Palo Verde deposits are about 37 miles by road from Glamis.

Manganese ore was mined and shipped from the deposits in the Chocolate Mountains in 1917 and 1918 and from the Palo Verde District early in 1917. Operations were suspended in the latter part of 1918 on account of the resumption of imports of high-grade foreign ores.

The Ebony Group, formerly known as the Ebony group of claims, is located in the northwestern section of the Palo Verde Mountains, six miles south of Wiley Well, and about 40 miles by road northeast of Glamis, a station on the Southern Pacific Railroad. The elevation is 1100 feet.

A number of narrow veins containing manganese and having a general northerly strike, occur in the basic lava. These veins are from a few inches to several feet in width. Psilomelane is the principal manganese oxide but it is more or less mixed with iron oxides and calcite. A number of shallow open-cuts have been made on the different vein outcrops, exposing 6 to 12 inches of manganese ore. No ore has been shipped from the property.

Bibl: State Mining Bureau Bull. 76, pp. 34–35.

Everharty or Tres Amigos Deposit is located in the Chocolate Mountains, 32 miles by road northwest of Glamis, a station on the Southern Pacific Railroad, in T. 11 S., R. 21 E., S. B. B. and M., in the Paymaster district. The elevation is 1200 feet.

The deposit was worked in 1917 by J. J. Everharty, who shipped a considerable quantity of high-grade ore. In 1918 the property was leased to the Tres Amigos Company, of Los Angeles, and a small amount of ore was shipped. It was then subleased to Suffern & Company, of New York, who operated the property until August, 1918, when it was relinquished to J. J. Everharty. It is reported that the greater part of the ore contained more than 40 per cent of manganese and less than 8 per cent of silica. The ore was hauled by motor truck to Glamis and then shipped to furnaces in Pennsylvania and Illinois.

The deposits of manganese ore are contained in fissure veins that cut both the sedimentary and igneous rocks. The veins strike from N. 10° W. to N. 50° E. The majority of the veins strike N. 25° E. and dip from 65° to vertical. These veins vary in width from one to four feet.

On what was formerly known as the Black Mountain Claim, a vein which strikes N. 10° W. and dips 80° E. has been exposed for a distance of 150 feet by two tunnels. A considerable tonnage of ore was mined from the upper tunnel. The vein can be traced southward from this tunnel for a distance of 1300 feet to another tunnel. Between these two tunnels are croppings of ore from one to four feet wide. The vein worked in the south tunnel was two feet wide.

A shear zone 10 feet wide which cuts volcanic breccia occurs on the southwest side of the arroyo. This zone contains numerous veinlets and seams of psilomelane for 100 feet along its strike. A tunnel 40 feet long has been run in this shear zone. A quarter of a mile south is a fissure vein which cuts an andesite breccia. This vein strikes N. 50° E. and dips 75° SE. The vein has been developed on the surface by an open-cut about 150 feet long, and by a tunnel 50 feet long. In the open-cut the vein exposed is three feet in width. The ore on the surface is hard and is mostly psilomelane but in depth the ore becomes softer and manganite and pyrolusite become more abundant.

Bibl: U. S. Geol. Surv. Bull. 710–E.

Palo Verde Deposits of manganese are located in the Palo Verde Mountains about five miles west of the wagon road between Palo Verde and Glamis, in T. 9 and 10 S., R. 19 E., S. B. B. and M. Elevation is 1000 feet.

Several claims were held on this deposit by T. Lugo, of Palo Verde. The deposit was worked in the early part of 1918 and a small quantity of ore shipped.

The manganese deposits are in a number of short veins or shear zones that cut basic lava flows. The veins strike N. 65° E. and are vertical. The vein material is from a few inches to several feet wide, and consists of fragments of basalt cemented together with manganese oxides and cut by veinlets of calcite. The veins have been developed by short tunnels and open-cuts. The ore shoots are short, being only a few feet in length. Psilomelane is the principal manganese oxide but it is more or less mixed with iron oxides and calcite.

Bibl: State Mineralogist's Report XVII, p. 269; U. S. Geol. Surv. Bull. 710–E.

Tolbard Manganese Deposit (Imperial Manganese Mines) is located on the southeast slope of a spur of the Chocolate Mountains, in T. 11 S., R. 21 E., S. B. B. and M., 30 miles northeast of Glamis by wagon road and 8 miles southeast of Midway Well. Elevation is 800 feet.

In 1917 O. S. Tolbard located three claims known as the Black Sheep No. 1, No. 2 and No. 3, on the hill east of the arroyo and on the southeast side of the north end of the Tres Amigos claims. Operations were begun by the Tolbard Mining Company in June, 1917, and considerable ore was produced from the property until the latter part of 1918 when operations were suspended. It is reported that ore shipped contained 46% manganese, 0.5% iron, and 2.5% silica. This property and the Tres Amigos group were relocated in 1925 by Page Bros., of Glamis, and it is reported that the Pacific Coast Steel Company, of Los Angeles, has purchased the claims.

The principal development work is on what was known as the Black Sheep claim. It consists of four tunnels and a shaft near the portal of one tunnel. Work on the other two claims consists of shallow open-cuts. The total amount of work amounts to about 600 feet.

The deposits of manganese ore are contained in fissure veins that cut both sedimentary and igneous rocks. Three veins have been worked on the Black Sheep claim. These veins can be traced for over 1000 feet but the ore has been mined from them in two shoots only, the longer being 400 feet. Other veins occur on these claims but they have not been explored to any extent. The veins vary in strike from N. 25° E. to N. 40° E., and dip from 65° to vertical, and vary in width from a few inches to four feet. The manganese oxides are mostly psilomelane, though with increasing depth the softer oxides, manganite and pyrolusite become more abundant. The cost of mining is said to have been from $6 to $10 per ton. Haulage from the mine to Glamis, a distance of 32 miles, costs $15 per ton.

Bibl: U. S. Geol. Surv. Bull. 710–E.

NICKEL.

Nickel occurs on the south slope of the Coyote Mountains. The extent of the deposit has not been determined as very little prospecting has been done on the surface outcrop. The ore is chiefly garnierite, a nickel-magnesium silicate.

SILVER.

Silver is found in the southeastern part of the county associated principally with copper, gold and lead ores. In the Paymaster district on the True Friend and Silver Moon claims it occurs in the form of argentite. The principal production of silver has been from the Paymaster Mine, where it occurs with galena and lead carbonate ores.

True Friend and Silver Moon Group of Mines. These claims are located three miles southeast of the Midway Well, which is on the Blythe-Glamis road, and about 20 miles northeast of Glamis, in an eastern spur of the Chocolate Range of Mountains, in the Paymaster district. These claims were located in 1914, and worked during 1915 and 1916. Frank Beal, of Brawley, is the owner.

The principal workings are on the True Friend claim, and are located on the northeast slope of the highest peak of the range. A vein of spar, principally barite stained with iron and manganese oxides, occurs on the contact of granitic gneiss and porphyry. It strikes N. 20° E., and dips 80° NW. This vein has a width of 15 to 20 feet. A tunnel has been driven S. 50° W., 150 feet; and 70 feet from the portal a crosscut has been driven west 50 feet. About 200 feet south of these workings, over the top of the ridge, is a shaft 50 feet deep. Ore occurs in lenses in the spar vein. It is reported that the ore mined assayed from $20 to $40 per ton in silver. Only assessment work is being done on the property. Idle.

ZINC.

Southern Star Group comprises four claims located four miles southwest of Coyote Wells in Sec. 30 and 36, T. 17 S., R. 8 and 9 E., S. B. B. and M., near the border of Mexico. Elevation is 175 feet. Owner, C. E. Weaver, of 105 E. First Street, Los Angeles.

In this area the formation is limestone overlain by about 200 feet of gravel wash. A six-inch stringer, mineralized with sphalerite, occurs in the gravel detritus. The ore extracted from this stringer is reported to assay from 20 to 60% zinc.

Development consists of a shaft and open-cuts made along the outcrop of the vein. The owner reports that a small tonnage of high grade zinc ore is on the dump. Two men are employed on development.

NON-METALLIC MINERALS.

The rapid growth of the cities of Imperial Valley and especially the city of San Diego, has increased the demand for both industrial and structural materials. Imperial Valley has a variety of commercial minerals, and a large tonnage of industrial materials are shipped north to the manufacturing centers along the Pacific Coast. Deposits of gypsum, marble and limestone occur in the western end of the county and within easy access to railroad transportation. Since the Fourteenth Report of the State Mineralogist was published, the extensive deposits of gypsum located in the Fish Mountains near the western border of the county, have been opened up by the Pacific Portland Cement Company and a 300-ton plant for the manufacture of plaster and other products built at Plaster City, on the San Diego and Arizona Railroad.

With the rapid growth of the towns of Imperial Valley, and the large amount of road construction, has come an increased demand for crushed rock products and several plants are under operation. The most important recent development has been the exploitation of the cyanite deposits near Ogilby, by the Vitrifax Company, of Los Angeles.

The principal non-metallic minerals occurring in the county are: clay, cyanite, gypsum, limestone, marble, pumice, soda, sulphur, strontium, but with the exception of cyanite, pumice and gypsum, these deposits are largely undeveloped.

CLAY.

Imperial County contains extensive deposits of river silt that has been used for the manufacture of common brick and tile.

Extensive exposures of Tertiary clays are found on the west margin of Imperial Valley toward Carrizo Creek. These clays are many miles in extent and of great thickness, but have not been prospected sufficiently to determine their value for commercial purposes. On these Tertiary clay deposits, a number of locations have been made by the Columbia Cement Company, of Los Angeles, and the American Portland Cement Company, of San Diego.

BRICK.

During the development of the towns of Imperial Valley, a number of local brickyards have been established and operated for a short time. *The Simons Brick Company*, of Los Angeles, is the only manufacturer of brick and tile in the valley at present writing and this company only operates the plant at intervals to supply the local demand. Simons Brick Company, main office, 125 West Third Street, Los Angeles, Walter R. Simons, president. The brick plant is located about one mile southeast of El Centro.

The clay used is local silt of the valley which is very fine and sticky. This deposit continues unchanged to a depth of 1500 feet as shown by local borings but varies slightly in texture and the proportion of sand present, the variations in composition occurring every 3 to 4 feet. This variation enables the brick maker to mingle layers of different qualities and form a brick mixture of suitable character.

The material from the clay pit is delivered by scrapers to the hopper, from which it goes to a belt conveyor, and is elevated to a set of rolls. The material from rolls is elevated by bucket elevator to a screen. The through size from the screen goes to two stiff-mud brick machines. The brick and tile go to drying sheds, then are oil fired in open field kilns. The plant is operated according to local demand only, and was idle at the time of visit.

Full Moon Clay Deposit. The deposit is located on the southwestern slope of the Chocolate Range of mountains, in T. 10 S., R. 16 E., S. B. B. and M., 8 miles north of Iris siding on the Southern Pacific Railroad.

Holdings comprise five claims known as the Full Moon group. Owner, J. Thebo, of La Mesa, California.

The clay is a white talclose clay, showing a high aluminum content. The development consists of a number of open cuts along the surface outcrop. Analysis of clay made by A. J. Forget, of Los Angeles:

Silica (SiO_2)	27.93%
Alumina (Al_2O_3)	42.33%
Iron (Fe_2O_3)	1.92%
Lime (CaO)	0.53%
Soda	0.70%
Water (combined)	12.44%
Moisture	0.74%
Sulphur Anhydride (SO_3)	13.39%
	100.00%

CYANITE AND DUMORTIERITE.

Cyanite (Al_2SiO_3 and dumortierite ($8Al_2O_3.\ B_2O_3.\ 6SiO_2\ H_2O$) are both aluminum silicates but with slightly different physical characteristics.

Cyanite is an aluminum silicate of the same chemical composition as andalusite and sillimanite, but crystallizing in the triclinic system; occurs usually in long-bladed crystals rarely terminated; hardness 5–7.25; gravity 3.56–3.67; color, blue.

An extensive deposit of cyanite occurs near Ogilby which is being developed by the Vitrifax Company, of Los Angeles.

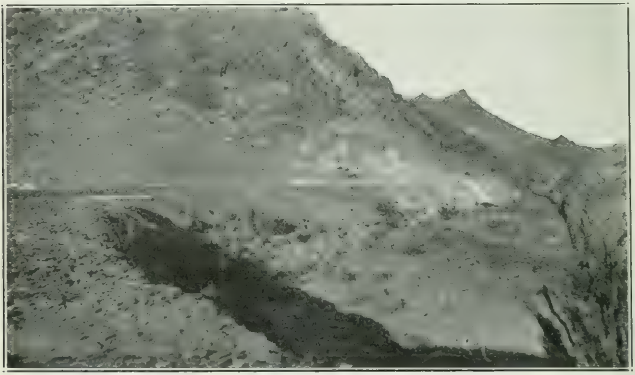
Dumortierite is a basic silicate of aluminum, with boron, but crystallizing in the orthorhombic system. It occurs usually in small prisms; color, blue, dark blue and violet-red; hardness 7, gravity 3.22–3.43.

Dark blue boulders of dumortiorite have been found in the washes in the Picacho district about 25 miles from Ogilby. These metamorphic minerals are found in the schists and gneisses.

Ogilby Cyanite Deposits. The deposits of cyanite occur near the base of hills on the western slope of the Cargo Muchacho range of mountains, three miles northeast of Ogilby. Elevation 500 feet. Holdings comprise ten claims known as the Drifted Snow and Blue Bird groups. 200 acres. Owner, Vitrifax Company, 5100 Pacific Boulevard, Los Angeles.

The first discovery of cyanite was made in a low, rounded hill one-eighth mile wide by one-half mile long, and probably consists of 25 per cent cyanite in a matrix of quartz. One-quarter of a mile farther east, a prominent vein of cyanite outcrops for one-half mile in length, at the foot of the Cargo Muchacho range. The vein, which occurs in a mica schist, is nearly vertical and varies from 10 to 200 feet in width. Open-cuts and tunnels have been made along the deposit for a distance of over 500 feet along the strike. The most extensive showing has been found on the north end of the deposit. Here it outcrops for over 200 feet in width. Quartz is the gangue mineral while small amounts of black tourmaline occur throughout the vein material. On the south end of the deposit, both walls of the vein have a selvage of talc.

Eight to ten men are employed in getting out material for shipment to the company's plant at Los Angeles where experiments are being carried on to remove the quartz gangue or free silica, to make it suitable for manufacture of high-grade porcelain ware.



Vitrifax Cyanite Deposit, Cargo Muchacho Range, near Ogilby, Imperial County.

GEMS.

The gem, turquoise, occurs on the eastern slope of the Chocolate Mountains on some claims owned by Chas. Allen and Frank Beal, of Brawley. These claims are located about two miles east of the Midway Well, on the trail to the True Friend and Silver Moon mines.

The turquoise is bluish-green in color and it occurs in pockets and nodules in a porphyritic rock. There has not been enough development on the deposit to determine the extent or the value of the turquoise for gem material.

GYPSUM.

In Imperial County there is a large deposit of gypsum on the north side of Fish Mountain and another extensive deposit on the south side of Carrizo Mountain. The deposit on the northwestern edge of the Fish Mountains occurs mainly in an immense deposit three miles in length from the southeast to the northwest, with an area of about 1000 acres.

The Fish mountains lie chiefly in T. 13 and 14 S., R. 9 and 10 E. The gypsum outcrops are in Secs. 19, 20, 29, 30, 32 and 33, T. 13 S., R 9 E., S. B. B. and M.

Since Report XIV of the State Mineralogist was published, the deposit was acquired in 1920 by the Imperial Gypsum and Oil Company, of Los Angeles, who developed the deposit and installed a narrow gauge railroad, 26 miles in length, from the mine to a point 3 miles north of Dixieland, on the San Diego and Arizona Railroad. At this junction of the two railroads, a small crushing plant was installed for the purpose of shipping the crushed rock to Los Angeles for the manufacture of stucco plaster.

In the latter part of 1924, the deposit and holdings of the Imperial Gypsum and Oil Company were purchased by the Pacific Portland Cement Company, Consolidated, of San Francisco. This company built a plaster manufacturing plant having a capacity of 300 tons per day, and a town for the employes, now known as Plaster City.

Carrizo Gypsum Deposit. A large deposit of gypsum occurs on the south side of Carrizo Mountain, 7 miles north of Carrizo Springs and 20 miles northwest of Coyote Wells, in T. 13 and 14 S., R 9 E., S. B. B. and M. Owners, Carl F. Schroder and Amon Moore, of Los Angeles.

The quality and extent of the deposit is very similar to that of the deposit to the northeast.

Coyote Mountain Gypsum Deposit. This deposit occurs on the south slope of the Coyote Mountain range, 3 miles northwest of Coyote Wells. Owners, M. A. Turner and associates, of San Diego.

The gypsum is exposed over an area of about 10 acres, has an average depth of 8 feet, and it is estimated that the deposit contains about 80,000 tons, with a continuation under the outcrop that cannot be determined. The quality of the gypsum is said to be the same as the Fish Mountain deposits.

Pacific Portland Cement Company, Consolidated. Robert T. Henderson, president; H. T. Battelle, secretary; J. H. Colton, general manager; C. F. Stahl, superintendent. Offices, 821 Pacific Building, San Francisco.

The plant is located at Plaster City, on the San Diego and Arizona Railroad, 16 miles west of El Centro. The holdings of the company comprise 1200 acres in the Fish Mountains, in Secs. 19, 20, 29, 30, 32 and 33, T. 13 S., R. 9 E., S. B. B. and M., 26 miles northeast of Plaster City.

The gypsum occurs as an immense deposit about three miles in length from southeast to northwest, and about three-quarters to one mile in width, with an average thickness of over 150 feet. The beds dip 15 to 25 degrees west. It is stated that the gypsum mined has the most uniform grade of any deposit in the United States, the average being 95% gypsum. The deposit may be said to contain an inexhaustible supply of commercial gypsum.

Analysis of the gypsum made by J. Wilkes Jones, chemist:

Sulphuric Anhydride (SO_3)	47.17%
Lime (CaO)	32.75%
Crystallized Water	18.75%
Silica (SiO_2)	.92%
Iron Oxide (Fe_2O_3)	.14%
Alumina (Al_2O_3)	.21%
Magnesia (MgO)	.08%
	100.02%

Gypsum Deposit of Pacific Portland Cement Company, Consolidated. Fish Mountains, Imperial County.

The gypsum values, calculated to $CaSO_4$, $2H_2O$, average better than 95% as shown by many of the company's analyses, and also by the report rendered by the Chemistry Division of the California Department of Agriculture. The quarry has been opened up for a distance of 2000 feet in length in a northwest direction, with an average height above the floor of the quarry of over 50 feet. The rock gypsum is first drilled with an Armstrong churn drill, and then a series of holes are blasted, breaking down a large tonnage. The broken material is loaded by a Marion steam shovel into 30-ton steel side-dump cars, then hauled in a train of 10 to 18 cars by locomotive to the plant at Plaster City.

Pacific Portland Cement Company's gypsum quarry showing steam shovel loading company's train of cars. Fish Mountains, Imperial County.

Gypsum Deposit of Pacific Portland Cement Company. Fish Mountains, Imperial County.

The equipment at the quarry consists of blacksmith and machine shops, buildings for employees, 260-cu. ft. Ingersoll Rand compressor, driven by 25-h. p., Fairbanks-Morse gas engine, Marion steam shovel, and one Armstrong churn drill.

Plant: The capacity of the gypsum plant at Plaster City is 300 tons per day. Rock from the quarry is dumped from cars into a 30″ x 44″ Ehrsam jaw crusher. The product from this crusher then goes to two 42-inch Ehrsam rotary crushers, producing 1½″ to 2″ product which is elevated to screens and screened to one-inch size, making a product suitable for cement retarder that is used in the manufacture of Portland cement. The over-size material from the screens goes to two Raymond roller mills, where it is ground to pass 200-mesh. Each Raymond mill is equipped with a set of Raymond exhausters for collection of the fine dust. The fine dust goes to storage bins, and is sold for agricultural gypsum. Following the grinding stage, the gypsum is ready to be made into various kinds of plaster. The process consists of removing the moisture from the raw product, which is made up of 20% water and 80% calcium sulphate. The material is calcined in three large kettles, each having a capacity of 10 tons of plaster. The powdered gypsum is mechanically fed from storage bins into the kettles, which are fired with oil burners underneath. The temperature of the kettles is about 212° Fahrenheit, when the powdered gypsum is injected. The heat is gradually increased until the water of crystallation in the gypsum is carried off as steam. The steam in rising floats the gypsum powder and gives it the appearance of boiling. This stage is reached at 340° Fahrenheit. A gear driven vertical shaft at the bottom of which is attached paddles, continually stirs the material in the kettles during the heating process. On the completion of the heating operation, the hot powder is run off into cooling bins, before mixing. The mixing

300-ton Plaster Mill. Pacific Portland Cement Company. Plaster City, Imperial County.

operation consists of running into the powdered gypsum desired amounts of retarder and binder, the latter usually being hemp.

The binder is only used in the manufacture of hard wall building plaster. The gypsum, retarder and binder are carefully weighed and mixed according to formulas supplied by the chemist in the laboratory of the plant. From the mixing bins, the material goes by gravity to three Bates automatic baggers, where the plaster is sacked for shipment. From the sacking room, the product is loaded into railroad cars.

In addition to manufacturing fertilizer, cement retarder, hard wall and finished building plasters, casting, moulding and dental plasters, the company manufactures Empire gypsum tile blocks for buildings.

Electric power is secured from the Southern Sierras Power Company. Water for operation of the plant is secured from Dixieland, while water for drinking purposes is secured from Coyote wells. Eighty men are employed at the plant.

The following is a list of the owners of other undeveloped deposits of gypsum located in the Fish Mountains:

F. L. Blanc owns 640 acres located in Sec. 30 and 31, T. 13 S., R. 9 E., and in Sec. 6, T. 14 S., R. 9 E., S. B. B. and M., located west of the Pacific Portland Cement Company's deposit.

Bert R. Chaplin, Suisun, owns 120 acres in SE¼ of SW¼, S½ of SE¼, Sec. 19, T. 13 S., R. 9 E., S. B. B. and M.

Both the Blanc and Chaplin deposits are under option to the Pacific Portland Cement Company.

W. F. Gillett, of Holtville, owns a deposit, comprising 40 acres located in N½ of NE¼ of NW¼; N½ of NW¼ of NW¼ of Sec. 33, T. 13 S., R. 9 E., S. B. B. and M.

Ed H. Houck, of Imperial, owns 40 acres located in the SW¼ of NW¼ of Sec. 28, T. 13 S., R. 9 E., S. B. B. and M.

W. H. Waters, of Dixieland, owns a deposit of gypsum adjoining the holdings of the Pacific Portland Cement on the south and located in the NW¼ of Sec. 4 and E½ of Sec. 5, T. 14 S., R. 9 E., S. B. B. and M., comprising 320 acres.

The gypsum is exposed in a cut to a depth of 60 feet and analysis shows that it will average 95 per cent gypsum.

LIMESTONE AND MARBLE.

The chief deposits of this material in Imperial County are in the Coyote Mountains, T. 15 S., R. 10 E., and the Fish Mountains in Sec. 1, 7 and 12, T 14 S., R. 9 E., S. B. B. and M.

These deposits of crystalline limestone are extensive, and due to the fact that this limestone has a low magnesia content makes it ideal for cement manufacture.

The raw materials for Portland cement are very abundant on the west side of the Imperial Valley, in great deposits of Tertiary clay and crystalline limestone which are close together and close to railroad transportation.

The chief deposits of marble are in the Coyote Mountains, T. 15 S., R. 10 E., S. B. B. and M. This mountain is largely formed of crystalline limestone but not all of it is fit for marble. Here valuable deposits within 6 miles of the San Diego and Arizona Railroad are owned and controlled by the Columbia Cement Company, of Los Angeles. This company has opened up a number of deposits, each deposit being of different grade and color. Several have the grade and texture of famous imported marbles.

Columbia Cement Company. Fred A. Ballin, president, Arthur Languth, secretary. Offices: National City Bank Building, Los Angeles.

This company controls 8000 acres of limestone, marble and clay deposits, situated in the Coyote Mountains, in T. 15 S. and 16 S., R. 9 and 10 E., S. B. B and M., 6½ miles northwest of Coyote Wells, on the main line of the San Diego and Arizona Railroad. Elevation 800 to 2300 feet.

Since the publication of Report XVII of the State Mineralogist, the Columbia Cement Company has acquired control of the holdings of the Southern California Marble Company, Golden State Mining and Marble Company, the Schrader and Moore and other minor holdings in this area.

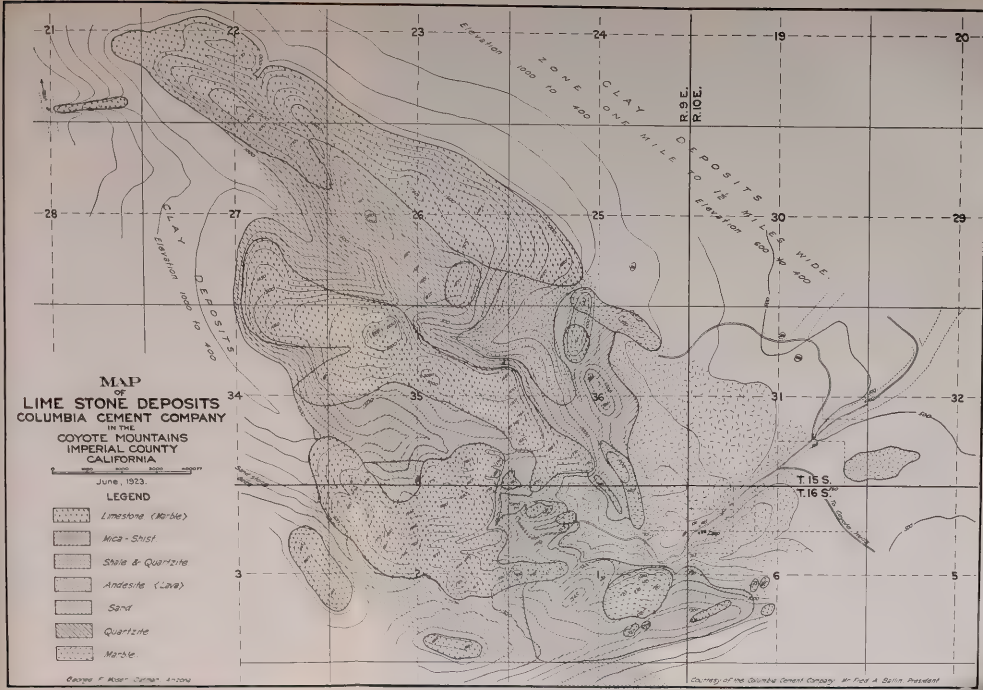
The deposits consist of limestone, marble and micaceous schist resting on andesite lava, at an elevation of 800 feet. Coyote Peak has an elevation of 2335 feet. The beds of blue-gray limestone, which are steeply tilted, dipping 70 degrees to the northeast, strike northwest. These beds of limestone are interstratified with beds of micaceous schist. This belt of limestone extends for three miles in length and has a width of about two miles. The major portion of the limestone is in Sec. 22, 26 and 35, T. 15 S., R. 9 E., and in Sec. 2, T. 16 S., R. 9 E. It is estimated that the available tonnage of commercial limestone is about 600,000,000 tons.

MARBLE.

The Creole Group consists of four claims covering an outcrop of marble about 4500 feet long and averaging 600 feet in width, located in the NE¼ of Sec. 36, T. 15 S., R. 9 E., S. B. B. and M. Here are three distinct strata of marble. The marble has a hardness of 3.5 and the colors range from blue-black, gray, white, mottled black and white, and blue. The deposit is estimated to contain 3,000,000 cubic feet of commercial marble.

Two quarries were opened up on this deposit by the Golden State Mining and Marble Company, of San Diego, the former owners. Equipment on the property consists of one derrick.

One mile south of this deposit, in Sec. 1, T. 16 S., R. 9 E., and in Sec. 35, T. 15 S., R. 9 E. are deposits of marbleized limestone that occur along a belt of limestone that strikes N. 30° W., and has a general dip of 70° E. Here the outcrops reach a height of 150 to 200 feet above the base of the exposure, and are from 100 to 200 feet in thickness, and between 500 and 1200 feet in length. A number of quarries were opened along this belt of limestone by the former owners, known as the Southern California Marble and Development Company, of San Diego. The marble that has been quarried is of fine texture, hard and takes an excellent polish, as shown by samples taken from the property. As a commercial marble it is said to rank with Georgia white and the English vein marble. These deposits are estimated to contain 200,000,000 cubic feet of commercial marble. In low hills east of the main range, the company owns a deposit of Tertiary clay, averaging 70 feet in thickness and covering more than 300 acres.



MAP OF LIME STONE DEPOSITS COLUMBIA CEMENT COMPANY IN THE COYOTE MOUNTAINS IMPERIAL COUNTY CALIFORNIA

June, 1923.

George F. Moser, Oatman, Arizona

Courtesy of the Columbia Cement Company. Mr Fred A. Ballin, President

Analysis of limestone made by Smith Emery Company, of Los Angeles, is as follows:

Mark	White	Blue
Silica (SiO_2)	1.00%	1.08%
Iron Oxide (Fe_2O_3)	0.05%	0.02%
Aluminum Oxide (Al_2O_3)	0.76%	Trace
Calcium Oxide (CaO)	54.32%	54.00%
Magnesium Oxide (MgO)	1.78%	1.48%
Loss on Ignition	42.05%	43.40%
	100.00%	99.98%

The carbonate of lime equivalent is 96.92% ($CaCO_3$).

The great deposits of Tertiary clay and crystalline limestone owned by the Columbia Cement Company form the basis for a large cement plant.

Bibl: State Mineralogist's Report XV, pp. 733–736; XVII, p. 238. Bull. 38, p. 107.

Mountain Springs Limestone Deposit. This deposit is located on the main highway from Jacumbo to El Centro, and is two miles east of Mountain Springs and 8 miles west of Coyote Wells.

Holdings comprise two claims owned by Dan Ruby, of Boulevard, California.

The belt of limestone strikes N. 30° E., and dips 60° SW. The beds of limestone are interstratified with schist. The beds have a thickness of 200 feet. The deposit was formerly operated by the Duralite Products Company, of San Diego.

Waters' Limestone Deposit. It comprises a group of claims located in Sec. 1, 7 and 12, T. 14 S., R 9 E., S. B. B. and M., 14 miles north of Coyote Wells, in the Fish Mountains. Holdings comprise 1200 acres owned by W. A. Waters, of Dixieland.

This is an immense deposit of crystalline limestone on the crest of the Fish Mountains, the major portion of the limestone being in Sec. 1 and 12, T. 14 S., R. 9 E., at elevations ranging from 1000 to 1600 feet. The belt of blue-gray limestone strikes N. 30° W. and dips 65° E. It is three miles long by one mile wide, and is exposed for a depth of 600 feet. Analysis of the limestone shows 97 to 98% $CaCO_3$ with only 0.7% $MgCO_3$.

In Sec. 31 and 32, T. 13 S., R 9 E., is another deposit of limestone that occurs on the east slope of the Fish Mountains. A tract of 160 acres is owned by W. A. Waters, of Dixieland. The quality of the limestone is not as good as the above mentioned deposit.

Analysis of limestone by John T. Rice, of El Centro, is as follows:

Sample Sec. 1 and 12		Sample Dixieland Claim
Calcium Carbonate ($CaCO_3$)	98.02%	90.02%
Magnesium Carbonate ($MgCO_3$)	.77%	.39%
Iron and Aluminum Oxides (Fe_2O_3 & Al_2O_3)	.83%	.72%
Insolubles	.34%	6.43%

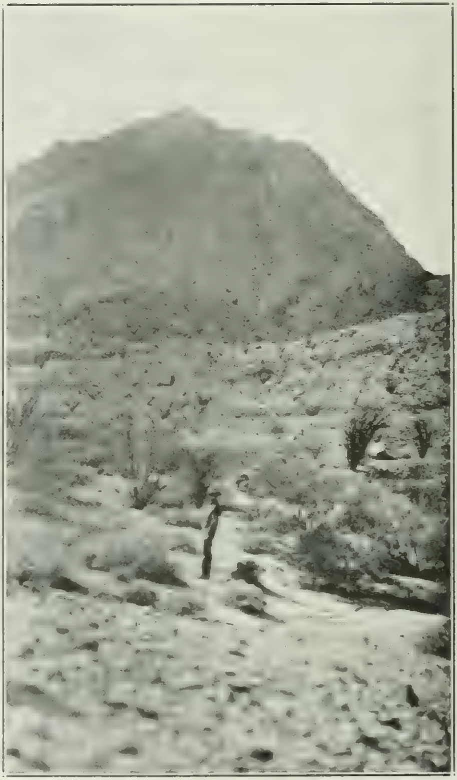
MINERAL PAINT.

Mullet Island Paint Deposit. A number of thermal springs occur on the north end of Mullet Island at the southeast end of the Salton Sea.

These springs deposit iron oxide about their vents in the form of yellow and red ocher. Capt. Chas. Davis, Niland, owner.

MINERAL SPRINGS.

Soda Springs. These are about 15 miles southeast of Fish Springs, on the road from Mecca down the west side of the Colorado Desert.



View of a mountain of limestone. Waters' Group of Claims. Fish Mountains, Imperial County.

The water is so salt as to be scarcely potable and near by are other springs whose water is entirely undrinkable. Soda Springs are at the base of a low barren knoll, one-half to three-quarters of a mile south of Clay Point, marked by a government bench mark, around which the road turns west on the way from Mecca to Seventeen Palms Springs. The road from Clay Point south toward Harper Well is very little traveled and is difficult to find.

Fish Springs. Fish Springs (230 feet below sea level), in 1908 submerged to a depth of about 25 feet beneath Salton Sea, are a group of strong natural springs whose aggregate yield is several miner's inches. The waters are tepid and slightly saline, but of sufficiently good quality to be used by men or animals without injurious effects. Before their submergence, these springs were especially important to travelers because they were at the southermost point at which water of fair quality can be procured in abundance along the west side of the desert until Harper (Mesquite) Well is reached. They will emerge again as the lake shrinks by evaporation, and when the lake water has become too saline for use they will again become important. Their position is indicated by a prominent rocky point which stands out in a desert about a mile east of the Santa Rosa Mountains, and which is conspicuous not only because of its position but because of the distinct water line that encircles it 10 to 15 feet below its summit. This point is about 2 miles northeast of the springs.

Frinks Springs. These are about 6 miles northwest of Frinks Station, on the Southern Pacific Railroad. They are on one of the old wagon roads from San Bernardino to Yuma, near the old beach line that stands about 40 feet above sea level in the Colorado Desert. The water is of good quality and in fair quantity.

McCain Springs. These springs are about 5 miles somewhat east of south of Clay Point, mentioned in the description of Soda Springs. They are in the center of a broad wash, locally called arroyo grande, and are marked by three large sand dunes from a quarter of a mile southwest. The surrounding country is traversed by numerous gulches from 6 to 20 feet in depth and often difficult to cross. The springs, which are well below sea level, have built up a small mound in the bed of the wash. The water appears to be charged with carbon dioxide gas and is fairly palatable.

Kane Spring. This is 6 miles east of Harper Well, on top of a low knoll. It is surrounded by cane, salt grass, and arrow weed. The water is full of soda and is very poor, being hardly fit for use.

Yuha Springs. These springs are located in a wash near the corner of Sec. 5, 6, 7, and 8 about 5 miles southeast of Coyote Well and a mile southwest of the derrick at the Yuha oil well. The stage road from San Diego to El Centro passes about 2 miles north of the springs. The water is impregnated with alkaline matter, but when used continuously is not unpleasant or harmful. In 1905 there was a trough and pump at the springs.

Sunset Springs. These springs, which have long been known, are about 13 miles south of east from Brawley, below the old beach which is so prominent a feature about the borders of the Colorado Desert. They are of less importance now than before the reclamation of so large a part of the Imperial Valley by irrigation with Colorado River water.

Bibl: U. S. G. S. Water Supply Paper No. 224, by W. C. Mendenhall from data of G. E. Bailey.

PUMICE.

Pumice is found at several places, especially interbedded with Tertiary sediments around Carrizo Creek and Superstition Mountain and east of the Salton Sea. The deposits on the Salton Sea have been worked for a number of years, and have produced a considerable tonnage. The material is of the vesicular, gray variety, and is sold for abrasive purposes.

California Pumice Deposit. This deposit is located in the obsidian buttes, on the southeast shore of the Salton Sea, in T. 11 S., R. 13 E., S. B. B. and M., 11 miles northwest of Calipatria. Calipatria Branch of the Pacific Southwest Trust and Savings Bank of Los Angeles, owner.

The pumice occurs on the east slope of a low, rounded hill, and is interbedded in the sediments. The pumice occurs in pieces that vary in size up to 12 inches, the average being about 2 to 4 inches. Only pieces over 2 inches are shipped. The material is mined in the open cuts by pick and shovel, and the pumice is sorted by hand. A team and scraper haul away the sand. Three men are employed.

Brand and Stevens Pumice Deposit. It is situated 9 miles northwest of Calipatria, in Sec. 33, T. 11 S., R. 13 E., S. B. B. and M., and consists of a group of placer claims embracing about a quarter section. Owners, H. W. Brand and E. E. Stevens, Los Angeles.

This deposit has been worked more or less continuously since 1917. The pumice covers probably 100 acres located on a low, rounded hill east of the Salton Sea. It has been mined from a large number of open cuts, to a depth of 15 feet. The pumice occurs in lumps of various sizes, the largest pieces not being over 10 inches, scattered throughout sediments that cover this area. The material is mined by pick and shovel. Pumice is sorted by hand, and teams and scrapers used to haul away the sand. The pumice is hauled to Estelle siding on the Southern Pacific Railroad, a distance of 7 miles. Six men are employed.

Bibl: State Mineralogist's Report XVII, pp. 270-271.

PYROPHYLLITE.

Pyrophyllite is a hydrous silicate of aluminum, $H_2Al_2Si_4O_{12}$. It resembles talc so closely in its properties it is generally classed as talc. It occurs in the schists and gneisses associated with cyanite, on the cyanite deposit owned by the Vitrifax Company, of Los Angeles near Ogilby. It is exposed in a number of places on the west contact of the deposit, and in workings shows widths of 6 to 8 feet. A number of years ago it was worked and shipped as talc.

SILICA.

Deposits of silica sand occur in the Coyote and Fish mountains that are suitable for the manufacture of glass.

Coyote Mountain Silica Deposit. A bedded deposit of silica sand occurs in the Coyote Mountains, in Sec. 1 and 2, T. 16 S., R. 9 E., S. B. B. and M., on the holdings of the Columbia Cement Company.

The deposit is located 7 miles north of Coyote Wells, a station on the San Diego and Arizona Railroad.

The bed of silica is about 50 feet thick and can be traced for one-quarter of a mile along a gulch west of No. 3 Marble Quarry. The sand is clean and white, and is suitable for the manufacture of glass. During 1921 and 1922 1200 tons of this sand was shipped to Los Angeles, and the price received for the product was $6.00 per ton.

Bibl: State Mineralogist's Report XVII, p. 271.

Fish Mountain Silica Deposit. This deposit of silica sand is located in the Fish Mountains, in Sec. 10 and 15, T. 14 S., R. 9 E., S. B. B. and M., 14 miles north of Coyote Wells, a station on the San Diego and Arizona Railroad. Owner, W. A. Waters, of Dixieland.

Exposure of salt cake (thenardite) in west open-cut, Bertram Sodium Sulphate Deposit, Imperial County. Photo by E. N. Smith.

Analysis and screening test made by John T. Rice, chemist, is as follows:

	Sample of Silica on 50 mesh and 50% of original	Sample of Silica minus 50 mesh
Silica (SiO_2)	86.00%	75.06%
Aluminum Oxide (Al_2O_3)	8.36%	19.23%
Iron Oxide (Fe_2O_3)	1.18%	.66%
Calcium Oxide (CaO)	3.06%	3.45%
Magnesium Oxide (MgO)	T_2	0.11%
Alkalies	.11%	.09%
Loss in Ignition	1.24%	1.27%
Totals	99.95%	99.877%

SODIUM SULPHATE.

Bertram Sodium Sulphate Deposit is located 2½ miles northeast of Bertram station on the Southern Pacific Railroad, in Sec. 19, T. 9 S.,

R. 12 E., S. B. B. and M. Elevation 125 feet below sea level. Holdings consist of 320 acres. Owner, E. N. Smith, El Centro, California.

The deposit is mainly thenardite, anhydrous sodium sulphate, which has a crystal form distinct from that of mirabilite, and is not so subject to alteration on exposure to the air. Mirabilite, glauber salt, is here associated with thenardite, usually on the top of the strata of thenardite. These parallel strata of sodium sulphate occur in the consolidated clay beds and sandstones which are extensively folded. The general strike of these beds is N. 70° W., dip 30° to 40° N. The above mentioned strata of thenardite have a thickness varying from 8 inches to 3 feet. The proved area containing sodium sulphate is about one-half mile wide and about 3000 feet in length. Samples taken from borings throughout this area are reported to carry 10 to 12% sodium sulphate. Workings consist of two open cuts: the one on the east end of the deposit is 600 feet long and 14 feet deep, the other which is located on the west end of the deposit, is 200 feet in length by 14 feet deep. During the early part of 1923, 2500 tons of salt cake was extracted and shipped by E. H. Otto and Company, of San Francisco.

Salt cake deposit (mainly thenardite) at Bertram station in the Salton Basin, Imperial County. Photo by E. N. Smith.

Samples of the sodium sulphate crystals collected by E. N. Smith were analyzed by Smith, Emery and Company, of Los Angeles, as follows:

Analysis of Sodium Sulphate from Bertram, California. Sample No. 1.

Water Insoluble	Trace
Iron and Aluminum Oxides	None
Calcium Oxide (CaO)	None
Magnesium Oxide (MgO)	Trace
Sodium Oxide (Na_2O)	43.64%
Moisture (105°)	.07%
Combined Water	.12%
Chlorine (Cl)	.10%
Boric Anhydride (B_2O_3)	None
Sulphuric Anhydride (SO_3)	56.22%
Total	100.15%

Hypothetical Combination:

Sodium Sulphate (Na_2SO_4)	99.80%
Sodium Chloride ($NaCl$)	.16%
Magnesium Sulphate ($MgSO_4$)	Trace
Moisture and Combined Water	.19%
Total	100.15%

Sodium sulphate is used in the making of wood pulp in the United States by the so-called sulphite process. It is also used in the manufacture of glass.

Bibl: State Mineralogist's Report XX, pp. 87-91.

Bertram salt cake deposit in Salton Basin, Imperial County, showing steam shovel at east open-cut. Photo by E. N. Smith.

STONE INDUSTRY.

(Sand and Crushed Rock.)

Due to the rapid growth of the cities of Imperial Valley, the demand for these building materials has lead to establishment of a rock crushing plant at Frink siding on the Southern Pacific Railroad.

Orange County Rock Company, Inc. H. G. Wright, president, O. W. Bachman, secretary, Orange, California. E. S. Cook, manager. Offices: El Centro.

The crushing plant is located at Frink siding, on the Southern Pacific Railroad. The capacity of the plant is 1500 tons per day. The material used is unconsolidated wash, containing boulders of schist, rhyolite, andesite and granitic gneiss. The gravel pit is located one mile north of the plant in the Coffey Spring wash from the Chocolate Mountains. The gravel from the pit is loaded into Western side dump cars by P. & H. Company steam shovel, and the train of cars is hauled by Plymouth gasoline motor, over broad gauge track to crushing plant. At the plant the material is crushed, washed and screened and the following products produced:

No. 1—1½″ to 2¼″.
No. 2—1″ to 1½″.
No. 3—½″ to 1″.
No. 4—3/16″ to ½″.

The plant is driven by a 75-h.p. Semi-Diesel engine. Water for washing purposes is secured from Frink Springs. Twelve to fifteen men are employed.

Dixieland Sand and Gravel Company, E. S. Cook, of El Centro, owner. This plant, consisting of elevator, revolving screen and storage bin, is located three miles west of Dixieland, near the state highway. The sand is delivered to the plant by scrapers. Four men are employed.

STRONTIUM.

Near the Fish Mountain gypsum deposit is a considerable body of celestite or strontium sulphate, capping a low hill on the north side of Fish Mountain. Here the celestite occurs in tilted sedimentary beds that are probably of Tertiary age. The deposit is 26 miles north of Plaster City, a station on the San Diego and Arizona Railroad, and several miles north of the Pacific Portland Cement Company's gypsum quarry.

The celestite deposit is the result of precipitation and is underlain by beds of gypsum. The ore is finely crystalline, and generally white in color. Several carloads were mined and shipped from this deposit during the early part of 1917 for the manufacture of strontium nitrate.

Bibl: State Mineralogist's Report XVII, pp. 271-272.

SULPHUR.

There are small exposures of sulphur on the east slope of Coyote Mountain, and also on the southeastern slope of the Chocolate Range of mountains.

Coyote Mountain Sulphur Deposit. It is located in SE¼ of Sec. 6, T. 16 S., R. 10 E., S. B. B. and M., about 7 miles north of Coyote Wells, a station on the San Diego and Arizona Railroad. Elevation 500 feet. A claim has been located on the deposit by M. A. Turner and associates, of San Diego.

The sulphur occurs along a fault fissure that strikes N. 70° E., which is 8 to 10 feet wide. The sulphur is apparently along fractures and seams in the rock. The outcrop is about 100 feet in length, and stands 20 feet above the surrounding country rock which is granite, schist and limestone.

Development consists of a short crosscut tunnel and open cut. Idle.

Full Moon Sulphur Deposit. It is located on the southwestern slope of the Chocolate Range of mountains, in Sec. 36, T. 10 S., R. 16 E., S. B. B. and M., 8 miles north of Iris siding on the Southern Pacific Railroad. Holdings comprise five claims known as the Full Moon Group. Owner, J. Thebo, La Mesa, California.

The deposit at this place seems to have been formed through solfataric action, the sulphur being deposited near the surface in fractures and seams of the adjacent rock, which is tufa. The principal showings are in an open cut 12 feet deep and 40 feet in length. Here pure sulphur is found in the seams of the rock, and is also scattered throughout the rock. The deposits appear to be superficial, and the rock impregnated by sulphur is about 10 to 15 feet thick. Considerable development has been done on the deposit in the way of shafts, open cuts and tunnels. Idle.

OIL FIELD DEVELOPMENT OPERATIONS.

By R. D. Bush, State Oil and Gas Supervisor.

From January 31, 1926, to and including May 1, 1926, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
ALAMEDA COUNTY:					
George L. Craig	14	3	3	1	
COLUSA COUNTY:					
W. B. Brown	31	15	4	1	
FRESNO COUNTY:					
Confidence Oil Co	31	19	15	17	Coalinga
Pacific Oil Co.	31	20	15	72	Coalinga
Premier Oil Co	24	20	14	16	Coalinga
Standard Oil Co	25	20	14	115	Coalinga
Superior Oil Co	31	20	15	8-B	Coalinga
Fresno United Oil Co	23	15	18	3	
Taylor Oil Co	5	13	22	1	
HUMBOLDT COUNTY:					
Eureka Oil Co	21	4	1	1	
KERN COUNTY:					
Union Oil Co	16	28	20	Miller & Lux 1	Belridge
Union Oil Co	23	28	20	Theta 1	Belridge
Devils Den Products Co	23	25	18	3	Devils Den
Pacific Oil Co	35	30	24	208	Elk Hills
C. C. M. O. Co	9	29	28	16	Kern River
Del Rey Oil Co	5	29	28	West 10	Kern River
George F. Getty	14	28	27	Lehnhardt 6	Kern River
George F. Getty	14	28	27	Lehnhardt 14	Kern River
George F. Getty, Inc	22	28	27	Tegeler 6	Kern River
George F. Getty, Inc	22	28	27	Tegeler 14	Kern River
Marland Oil Co.	16	28	27	Cauley 139	Kern River
Cymric Oil Co	26	29	21	4	McKittrick
Wellington Oil Co.	2	30	21	1	McKittrick
Associated Oil Co	20	31	23	2	Midway
Associated Oil Co	2	31	22	71	Midway
Balboa Oil Co	24	31	23	27	Midway
Balboa Oil Co.	24	31	23	41	Midway
Balboa Oil Co	24	31	23	54	Midway
Balboa Oil Co.	24	31	23	55	Midway
Big Ten Oil Co.	36	32	23	25	Midway
California Petroleum Corp	34	32	24	Dorothy 5	Midway
California Star Oil Co	26	31	22	10-A	Midway
Caribou Oil Mining Co	32	31	23	12	Midway
E. & M. Oil Co	10	31	22	12	Midway
General Petroleum Corp	19	31	23	2	Midway
King G. Gillette	21	31	22	A-3	Midway
King G. Gillette	21	31	22	A-4	Midway
King G. Gillette	21	31	22	B-2	Midway
King G. Gillette	21	31	22	B-3	Midway
Honolulu Consolidated Oil Co.	4	32	24	11	Midway
Honolulu Consolidated Oil Co.	4	32	24	21	Midway
Honolulu Consolidated Oil Co.	4	32	24	22	Midway
Honolulu Consolidated Oil Co.	4	32	24	25	Midway
Honolulu Consolidated Oil Co.	8	32	24	38	Midway
Honolulu Consolidated Oil Co.	4	32	24	41	Midway
Honolulu Consolidated Oil Co.	4	32	24	42	Midway
Honolulu Consolidated Oil Co.	8	32	24	48	Midway
Honolulu Consolidated Oil Co.	4	32	24	64	Midway
North American Oil Cons	32	31	24	6	Midway
North American Oil Cons	30	31	24	29	Midway
North American Oil Cons	30	31	24	30	Midway
North American Oil Cons	30	21	24	34	Midway
North American Oil Cons	30	31	24	36	Midway
North American Oil Cons	30	31	24	39	Midway
North American Oil Cons	30	31	24	40	Midway
North American Oil Cons.	30	31	24	41	Midway

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
North American Oil Cons.	30	31	24	42	Midway
Pacific Oil Co.	33	31	24	13	Midway
Pacific Oil Co.	33	31	24	15	Midway
Pacific Oil Co.	29	31	24	41	Midway
Pacific Oil Co.	3	32	24	42	Midway
Pacific Oil Co.	19	31	24	53	Midway
Pacific Oil Co.	19	31	24	54	Midway
Pacific Oil Co.	33	31	24	54	Midway
Pacific Oil Co.	33	31	24	59	Midway
Pacific Oil Co.	5	32	24	62	Midway
Pan American Petroleum Co.	19	31	23	4	Midway
Pan American Petroleum Co.	19	31	23	5	Midway
Security Development Co.	15	31	22	11	Midway
Standard Oil Co.	29	31	24	43	Midway
Standard Oil Co.	33	31	24	50	Midway
Standard Oil Co.	33	31	24	53	Midway
Standard Oil Co.	19	31	24	55	Midway
Standard Oil Co.	31	31	24	61	Midway
Standard Oil Co.	31	31	24	62	Midway
Union Oil Co.	32	31	24	Buena Vista 4	Midway
The United Oil Co.	6	31	23	1	Midway
The United Oil Co.	19	31	23	Calidon 6	Midway
The United Oil Co.	20	31	23	United 2	Midway
The United Oil Co.	20	31	23	United 3	Midway
Valley Oil Co.	14	31	22	6	Midway
Western Production Co.	21	31	22	5	Midway
Lewis Petroleum Co.	34	12	24	G-M 13	Sunset
Lewis Petroleum Co.	34	12	24	G-M 14	Sunset
Lewis Petroleum Co.	34	12	24	G-M 15	Sunset
Obispo Oil Co.	32	12	23	11	Sunset
The United Oil Co.	32	12	23	Transport 2	Sunset
Standard Oil Co.	27	11	20	Kern Co. Lease No. 2 23	Wheeler Ridge
Robert Barry	35	26	18	2	
Buchner Brothers	22	26	28	1	
George F. Getty, Inc.	20	27	27	Marland 1	
B. C. Mackey	23	11	11	1	
Marland Oil Co.	27	26	20	Lazard 1	
R. B. McIlroy	3	10	23	1	
Milham Exploration Co.	16	28	23	Hyde 1	
Milham Exploration Co.	32	11	22	Pioneer 1	
Shell Co.	9	27	28	Vedder 1	
Joseph Stalder	12	11	23	1	
LOS ANGELES COUNTY:					
Shell Co.	33	3	13	Reyes 32	Dominguez
Shell Co.	34	3	13	Reyes 33	Dominguez
Shell Co.	33	3	13	Reyes 101	Dominguez
Shell Co.	33	3	13	Reyes 3-B	Dominguez
Union Oil Co.	33	3	13	Callender 13	Dominguez
Union Oil Co.	33	3	13	Callender 14	Dominguez
Union Oil Co.	33	3	13	Hellman 14	Dominguez
Pacific Oil Co.	17	2	14	46	Inglewood
Pacific Oil Co.	8	2	14	Baldwin 37	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 51	Inglewood
Standard Oil Co.	16	2	14	Baldwin 61	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 42	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 43	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 44	Inglewood
Standard Oil Co.	16	2	14	Stocker 5	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 10	Inglewood
Francis D. Adams	13	4	13	1	Long Beach
Ambassador Petroleum Co.	13	4	13	Ambassador A-1	Long Beach
Ambassador Petroleum Co.	18	4	12	Ambassador A-2	Long Beach
B. K. & M. Oil Co.	13	4	13	Brown 1	Long Beach
B. K. & M. Oil Co.	13	4	13	Gibson 1	Long Beach
Barham & Leeper Oil Co.	18	4	12	1	Long Beach
Braly & Slade No. 3	13	4	13	Tetenman 1	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Breslin, Woodward & Sheedy	13	4	13	Breslin, Woodward & Sheedy 2	Long Beach
Breslin, Woodward & Sheedy	13	4	13	Breslin, Woodward & Sheedy 3	Long Beach
Breslin, Woodward & Sheedy	13	4	13	Breslin, Woodward & Sheedy 4	Long Beach
J. W. Bucklin	13	4	13	Bucklin 1	Long Beach
Bush-Voorhis Oil Co.	13	4	13	16	Long Beach
California Petroleum Corp.	13	4	13	Frye 1	Long Beach
California Petroleum Corp.	13	4	13	Frye 2	Long Beach
California Petroleum Corp.	18	4	12	Jotham Bixby 1	Long Beach
California Petroleum Corp.	24	4	13	Otto Comm. 1	Long Beach
C. W. Camp	13	4	13	Camp 1	Long Beach
Casa Blanca Oil Co.	19	4	12	Casa Blanca 3	Long Beach
B. H. Cochran	13	4	13	Cochran 1	Long Beach
Charles B. Colby	13	4	13	Extension 1	Long Beach
Craig, Burns & Co., Inc.	13	4	13	Delaney 18	Long Beach
Davis & MacMillan Co.	13	4	13	11	Long Beach
A. J. Delaney	13	4	13	Delaney 7	Long Beach
A. J. Delaney	13	4	13	Delaney 10	Long Beach
A. J. Delaney	13	4	13	Delaney 11	Long Beach
A. J. Delaney	13	4	13	Delaney 14	Long Beach
A. J Delaney	13	4	13	Delaney 16	Long Beach
A. J. Delaney	13	4	13	Delaney 17	Long Beach
A. J. Delaney	18	4	12	Delaney 20	Long Beach
A. J. Delaney	13	4	13	Delaney 21	Long Beach
A. J. Delaney	13	4	13	Delaney 23	Long Beach
A. J. Delaney	13	4	13	Delaney 24	Long Beach
A. J. Delaney	13	4	13	Delaney 25	Long Beach
A. J. Delaney	13	4	13	Delaney 29	Long Beach
A. J. Delaney	13	4	13	Delaney 30	Long Beach
A. J. Delaney	13	4	13	Delaney 31	Long Beach
L. T. Edwards	13	4	13	Hines 1	Long Beach
Elbe Oil Land Development Co.	13	4	13	Elbe 7	Long Beach
Elbe Oil Land Development Co.	13	4	13	Elbe 8	Long Beach
Featherstone & Preston	13	4	13	Featherstone 16	Long Beach
W. F. Garrison	19	4	12	Felicia M. Hogan 1	Long Beach
Gem Oil Co.	13	4	13	2	Long Beach
General Petroleum Corp.	19	4	12	K. & H. 7	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 14	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 15	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 16	Long Beach
J. R. Gray	18	4	12	1	Long Beach
Halbert & Smith	13	4	13	1	Long Beach
Henderson Petroleum Corp.	13	4	13	26	Long Beach
Hornaday Oil Co.	13	4	13	1	Long Beach
George W. Johnson	13	4	13	7	Long Beach
George W. Johnson	13	4	13	4-A	Long Beach
F. S. Jones	13	4	13	1	Long Beach
Julian Petroleum Corp.	13	4	13	Bruce 1	Long Beach
Julian Petroleum Corp.	13	4	13	Chandler 1	Long Beach
Julian Petroleum Corp.	13	4	13	Fee 1	Long Beach
Julian Petroleum Corp.	13	4	13	Fee 2	Long Beach
Julian Petroleum Corp.	13	4	13	Fee 3	Long Beach
Julian Petroleum Corp.	13	4	13	Hughes 1	Long Beach
Julian Petroleum Corp.	13	4	13	Laughlin 1	Long Beach
Julian Petroleum Corp.	13	4	13	Mills 1	Long Beach
Kaweah Petroleum Co.	13	4	13	Kaweah 1	Long Beach
Keck Syndicate No. 5	13	4	13	Modoc 4	Long Beach
Keck Syndicate No. 5	13	4	13	Modoc 5	Long Beach
Kenney & Macrate	13	4	13	Kenney & Macrate 3	Long Beach
W. Irving Lake	13	4	13	2	Long Beach
W. C. Lance	13	4	13	1	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Law & Sanders	13	4	13	1	Long Beach
Lindauer Oil Co.	13	4	13	6	Long Beach
Lindauer Oil Co.	13	4	13	7	Long Beach
Lindauer Oil Co.	13	4	13	8	Long Beach
Lindauer Oil Co.	13	4	13	10	Long Beach
Magnolia Petroleum Syn. No. 1	13	4	13	2	Long Beach
Marine Corp.	13	4	13	55	Long Beach
Marine Corp.	13	4	13	56	Long Beach
Marine Corp.	13	4	13	60	Long Beach
McKeon Drilling Co., Inc.	13	4	13	Pantages 1	Long Beach
M. W. McVey	13	4	13	McVey 1	Long Beach
George E. Merrill	13	4	13	1	Long Beach
E. J. Miley	13	4	13	Los Cerritos 3	Long Beach
E. J. Miley	13	4	13	Los Cerritos 4	Long Beach
Northwest Gasoline Co.	13	4	13	1	Long Beach
J. E. O'Donnell	13	4	13	O'Donnell 55	Long Beach
Ort & Homer	18	4	12	1	Long Beach
Painted Hills Oil Assn.	13	4	13	10	Long Beach
Pan American Petroleum Co.	19	4	12	Chainey 2	Long Beach
R. F. Parks	13	4	13	Hale-Parks 1	Long Beach
Peacock & Lyons	13	4	13	1	Long Beach
W. A. Playter	13	4	13	Bunny 2	Long Beach
W. A. Playter	18	4	12	Bunny 3	Long Beach
Queen & Scott	13	4	13	Scott 2	Long Beach
Raburne Oil Co.	13	4	13	3	Long Beach
Repetto Hills Petroleum Corp.	13	4	13	5	Long Beach
Retsof Drilling Co.	13	4	13	78-A	Long Beach
Ring Petroleum Corp.	13	4	13	5-A	Long Beach
J. T. Robertson Co.	13	4	13	5	Long Beach
S. M. & F. Oil Co.	18	4	12	S. M. & F. 1	Long Beach
San Martinez Oil Co.	29	4	12	Booth Comm. 6	Long Beach
Sharp & Redick	13	4	13	Sharp-Redick 1	Long Beach
Southern States Petroleum Corp.	13	4	13	4	Long Beach
Star Petroleum Co.	13	4	13	Colby 2	Long Beach
Walter P. Temple Oil Co.	13	4	13	2	Long Beach
Walter P. Temple Oil Co.	18	4	12	4	Long Beach
Walter P. Temple Oil Co.	13	4	13	5	Long Beach
Walter P. Temple Oil Co.	18	4	12	Olson 1 3	Long Beach
W. O. Todd	18	4	12	2	Long Beach
United Oil Co.	13	4	13	American 1	Long Beach
United Oil Co.	13	4	13	American 2	Long Beach
United Oil Co.	13	4	13	Barnes 1	Long Beach
United Oil Co.	13	4	13	Ketchum 1	Long Beach
Vlasnik & Roberts	13	4	13	Vlasnik & Roberts 1	Long Beach
W. M. C. Oil Co.	13	4	13	2	Long Beach
W. M. C. Oil Co.	13	4	13	3	Long Beach
Harry Williamson	13	4	13	Harry Williamson 1	Long Beach
Wilshire Oil Co., Inc.	13	4	13	Wilshire A-2	Long Beach
Wilshire Oil Co., Inc.	13	4	13	Wilshire A-3	Long Beach
Wilshire Oil Co., Inc.	13	4	13	Wilshire B-1	Long Beach
Wilshire Oil Co., Inc.	13	4	13	Wilshire B-2	Long Beach
Wilshire Oil Co., Inc.	13	4	13	Wilshire C-1	Long Beach
Wilshire Oil Co., Inc.	13	4	13	Wilshire C-2	Long Beach
Wilshire Oil Co., Inc.	13	4	13	Wilshire D-1	Long Beach
McGinley Oil Co.	6	2	11	3-B	Montebello
St. Helens Petroleum Co., Ltd.	2	2	12	Mulholland 3	Montebello
St. Helens Petroleum Co., Ltd.	6	2	11	Piuma-Briano 5	Montebello
St. Helens Riverside Properties	2	2	12	Monterey 12	Montebello
Standard Oil Co.	6	2	11	Baldwin 66	Montebello
Standard Oil Co.	6	2	11	Baldwin 67	Montebello
Standard Oil Co.	2	2	12	Harvey 1	Montebello
Standard Oil Co.	2	2	12	Howard & Smith 3	Montebello
Standard Oil Co.	6	2	11	Temple 17	Montebello
Union Oil Co.	2	2	12	La Merced 28	Montebello
Henry R. Dabney	8	3	16	McCormick 1	Newhall

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Barnsdall Oil Co.	18	3	13	O'Dea 10	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 11	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 12	Rosecrans
Fred E. Cole	18	3	13	1	Rosecrans
General Petroleum Corp.	18	3	13	Vaughn 3	Rosecrans
Union Oil Co.	18	3	13	Howard Park 27	Rosecrans
Bandini Petroleum Co.	5	3	11	Off 7	Santa Fe Springs
California Petroleum Corp.	5	3	11	Wickman 2-B	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 20	Santa Fe Springs
C. C. M. O. Co.	9	4	14	Del Amo 52	Torrance
C. C. M. O. Co	9	4	14	Del Amo 58	Torrance
C. C. M. O. Co	9	4	14	Del Amo 63	Torrance
C. C. M. O. Co	8	4	14	Del Amo 68	Torrance
C. C. M. O. Co.	8	4	14	Del Amo 74	Torrance
C. C. M. O. Co	8	4	14	Del Amo 98	Torrance
C. C. M. O. Co	10	4	14	Torrance 89	Torrance
California Petroleum Corp	5	4	14	Redondo Imp. Co. 5	Torrance
Fullerton Oil Co	8	4	14	Waddell 6	Torrance
Petroleum Securities Co.	22	4	14	Hogan 1	Torrance
R. & D. Oil Co.	9	4	14	2	Torrance
Shell Co.	8	4	14	Redondo Comm. 1	Torrance
Shell Co.	8	4	14	Redondo Comm. 9	Torrance
Shell Co.	8	4	14	Redondo Comm. 11	Torrance
Shell Co.	9	4	14	Redondo Imp. Co. 12	Torrance
Superior Oil Co.	24	4	14	Torrance 29	Torrance
W. E. McCaslin	17	2	11	Patten-Gregg 1	Whittier
Pan American Petroleum Co.	17	2	11	Broderick 1	Whittier
Petroleum Securities Co	17	2	11	Rideout Heights 1	Whittier
South Slope Oil Co.	16	2	11	Childs 3	Whittier
B. J. Jeffrey	7	1	14	2	
George W. Johnson	30	3	14	G. C. Martin 1	
Julian Petroleum Corp.	19	3	14	Hellman Bank Trust 1	
Petroleum Securities Co.	36	4	14	Palos Verdes 1	
Shell Co	11	5	12	Bryant 4	
Standard Oil Co.	15	2	15	University 1	
Union Oil Co	2	5	12	Bryant 1	
NAPA COUNTY:					
H. Rambke	29	8	3	2	
ORANGE COUNTY:					
Birch Oil Co.	2	3	10	1-A	Brea Olinda
Shell Co	1	3	10	Fisher 4	Brea Olinda
Shell Co.	2	3	10	Orange 11	Brea Olinda
Shell Co	2	3	10	Orange 12	Brea Olinda
Shell Co	2	3	10	Orange 13	Brea Olinda
Shell Co	2	3	10	Pico 5	Brea Olinda
Union Oil Co	6	3	9	Stearns 68	Brea Olinda
California Petroleum Corp.	28	5	11	Buck 1	Huntington Beach
Golden Dome Oil Co	2	6	11	Ward 1-A	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B 45	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B B-46	Huntington Beach
Standard Oil Co	12	6	11	Thomson 7	Huntington Beach
The United Oil Co	2	6	11	Pacific 1	Huntington Beach
Bar-Mor Petroleum Corp.	21	6	10	1	Newport
Julian Petroleum Corp	21	6	10	Mesa 6	Newport
Owl Oil Co	28	6	10	2	Newport
California Petroleum Corp.	28	3	9	Yarnell 19	Richfield
California Petroleum Corp.	28	3	9	Yarnell 20	Richfield
General Petroleum Corp	28	3	9	Stern 6	Richfield

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Continued.					
Herndon-Hunter	29	3	9	1	Richfield
Standard Oil Co.	34	3	9	Anaheim Union Water Co. 1	Richfield
Standard Oil Co.	29	3	9	Kraemer 2 21	Richfield
Union Oil Co.	29	3	9	Coyle 5	Richfield
Union Oil Co.	29	3	9	J. W. Newell 5	Richfield
SAN MATEO COUNTY:					
Steele Brothers	------	7	4	1	
SANTA BARBARA COUNTY:					
Searoad Asphaltum & Ref. Co.	------	4	25	2	
Searoad Asphaltum & Ref. Co.	------	4	25	4	
STANISLAUS COUNTY:					
J. G. Tavares	12	7	8	1	
VENTURA COUNTY:					
Montebello Oil Co.	4	3	19	Shiells 93	Bardsdale
Surprize Oil Syn.	33	2	20	14	Conejo
B. B. & N. Oil Co.	13	4	19	6	Piru
Temescal Petroleum Co.	3	4	18	Landers 3	Piru
H. A. Ivers	1	4	20	8	Sespe
Sentinel Oil Co.	5	5	19	1	Sespe
Hoyt S. Gale	29	2	21	Beardsley 2	Simi
Shell Co.	33	3	20	Berylwood 1	Simi
Oak Ridge Oil Co.	13	3	21	South Mountain 7	South Mountain
Associated Oil Co.	27	3	23	Lloyd 33	Ventura
G. J. Magenheimer	22	3	23	Hartman 1	Ventura
Petroleum Securities Co.	28	3	23	Orton 1	Ventura
Shell Co.	28	3	23	Edison 5	Ventura
Shell Co.	28	3	23	Edison 8	Ventura
Shell Co.	27	3	23	Gosnell 8-A	Ventura
Shell Co.	28	3	23	Gosnell 21	Ventura
Shell Co.	28	3	23	Gosnell 22	Ventura
Shell Co.	29	3	23	Taylor 12	Ventura
Shell Co.	28	3	23	Taylor 13	Ventura
H. V. Gentry Corp.	1	1	21	1	
Standard Oil Co.	17	2	22	Haydock 1	
Standard Oil Co.	17	2	22	Valentine 1	
YUBA COUNTY:					
Thomas M. Blake	7	15	5	1	

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

THE FEDERAL REVENUE ACT AND THE MINING INDUSTRY.

It appears to be the consensus of opinion that the new federal revenue act, which was approved and signed by President Coolidge February 26, 1926, has dealt fairly with the mining industry and that operators should be gratified by the inclusion therein of a number of favorable provisions.

That the new law will reduce the tax burden of the industry and greatly simplify procedure is gathered from an analysis of the act in its relation to the mining industry, by Robert Murray Haig[1], Engineering and Mining Journal-Press; a feature article on the subject in the Mining Congress Journal, March 1926; and other published comment.

Briefly, the outstanding features of the new law are stated to be the repeal of the capital stock tax and changes in the discovery and depletion clauses in relation to oil and gas wells and ore deposits. The law reduces the surtax rate to a maximum of 20%; increases the corporation tax to 13% for 1925 and to 13½% for 1926 and subsequent years; and fixes oil depletion at 27½% of gross income. Rates on individuals have also been reduced.

Capital stock tax.

The repeal of this tax will relieve mining companies of considerable direct expense as well as simplifying corporate accounting, as it will no longer be necessary to file reports covering two different accounting periods. The former tax was especially burdensome on mining enterprises in the development stage.

Depletion.

On account of difficulties in the administration of the discovery depletion provision of the law in the case of oil and gas wells, an amendment was adopted which provides that in the case of oil and gas wells the allowance for depletion shall be 27½ per cent of the gross income from the property during the taxable year, subject, however, to the limitation that such allowance shall not exceed 50 per cent of the net income computed without deducting depletion. Some consideration was given to the question of placing mine depletion on a percentage basis; but brief discussion made it apparent that a percentage could not be agreed upon which would be acceptable to all branches of the mining industry. Short-life lead and zinc mines would be entitled to a higher rate than long-life copper and iron mines; coal mines would require a different rate from metal mines; and the possibility of securing an adequate rate for each class or group was so slight, and the danger of jeopardizing the principle so great, that the subject was dropped.

---

[1] Haig, Robert Murray, "Analysis of the Federal Revenue Act of 1926," Engineering and Mining Journal-Press, Vol. 121, No. 10, March 6, 1926.

In any event, the new law is intended to reduce the aggregate depletion allowance to the oil industry, and to increase slightly the aggregate allowance for discovery depletion to the mining industry.

Mineral discoveries.

The administration of the discovery depletion provision never has been satisfactory either to taxpayers or to the income tax unit. Differences of opinion among the valuation engineers of the mining section of the income tax unit, as well as between the engineers and representatives of the taxpayers, operated to prevent the proper application of the law to mineral discoveries. The departmental interpretation that finally prevailed so circumscribed the law that it applied only to a few isolated cases where discoveries were made in tracts on which practically no mining operations had occurred. The department in 1924 attempted to correct this injustice by an amendment to the regulations which permitted the allowance of discovery value in the case of "one or more separate new ore bodies which have not been and could not have been included in any prior valuation."

The new law provides that discoveries shall include minerals in commercial quantities contained within a vein or deposit discovered in an existing mine or mining tract by the taxpayer after February 28, 1913, if the vein or deposit thus discovered was not merely the uninterrupted extension of a continuing commercial vein or deposit already known to exist and if the discovered minerals are of sufficient value and quantity that they could be separately mined and marketed at a profit.

It is a well-known fact that old mines in California, Colorado and Nevada have recently been opened up and in many cases new and valuable ore deposits discovered therein. It is clearly the intention of Congress that this provision should extend to such ore deposits since they are true discoveries having no relation to or connection with the ores previously extracted from these mines. In the case of an interrupted or separate vein or other formation, where, by reason of faults, dykes, or displacements, or lack of mineralization, the vein or deposit could not have been known to exist except through prospecting, exploration and discovery, discovery value should be allowable, and is as fully justified as in the case of a discovery of mineral in so-called virgin territory.

Discovery depletion section of the act.

This section reads as follows:

Sec. 204 (*c*). The basis upon which depletion, exhaustion, wear and tear, and obsolescence are to be allowed in respect of any property shall be the same as is provided in subdivision (*a*) or (*b*) for the purpose of determining the gain or loss upon the sale or other disposition of such property, except that

(1) In the case of mines discovered by the taxpayer after February 28, 1913, the basis for depletion shall be the fair market value of the property at the date of discovery or within thirty days thereafter, if such mines were not acquired as the result of purchase of a proven tract or lease, and if the fair market value of the property is materially disproportionate to the cost. The depletion allowance based on discovery value provided in this paragraph shall not exceed 50 per centum of the net income of the taxpayer (computed without allowance for depletion) from the property upon which the discovery was made, except that in no case shall the depletion allowance be less than it would be if computed without reference to discovery value. Discoveries shall include minerals in commercial quantities contained within a vein or deposit discovered in an existing mine or mining tract by the taxpayer after February 28, 1913, if the vein or deposit thus discovered was not merely the uninterrupted extension of a continuing commercial vein or deposit already known to exist, and if the discovered minerals are of sufficient value and quantity that they could be separately mined and marketed at a profit.

(2) In the case of oil and gas wells the allowance for depletion shall be 27½ per centum of the gross income from the property during the taxable year. Such allowance shall not exceed 50 per centum of the net income of the taxpayer (computed without allowance for depletion) from the property, except that in no case shall the depletion allowance be less than it would be if computed without reference to this paragraph.

In line with this subject, the illuminating editorial in the Mining Congress Journal of March, 1926, which is accompanied by a table showing comparative profits and taxes paid by various industries, so clearly sets forth the excessive tax burden now borne by the mining industry, that it is here quoted in full.

TAXING THE MINING INDUSTRY.

"It is frequently said and generally accepted that the power to tax is the power to destroy. It is somewhat humiliating to the American Mining Congress to admit that after its efforts to secure fair treatment for the mining industry in the matter of federal taxation and the great advantage which has been brought to the mining industry by virtue of the depletion and discovery clauses of the internal revenue law, that the mining industry is still paying an amount of taxes largely in excess of the proportion paid by any other industry.

"There are many who have pretended to believe that the depletion clauses of all of the revenue acts since 1916 gave an undue advantage to the mining industry, and there are some who have pretended to believe that the discovery clause gave the mining industry an unjust and unfair advantage. There have been members of Congress in both the House and the Senate who have assailed these provisions, and a distinguished member of the Ways and Means Committee of the House recently made the statement that the present bill will entirely relieve the mining industry of all tax obligations. We have no doubt that this statement was made with full belief in its truthfulness.

"An investigation of the actual facts show conclusively that the mining industry is paying a larger share of taxes in proportion to its ability to pay than any other industry, and from the record there can be no inducement left to engage in the mining business. The development of mineral resources is necessarily filled with hazard. An engi-

Table Showing Summary of Gross Receipts, Net Profits, Taxes Paid and Percentages of Same for All Corporations by Industrial Divisions for Year 1923. Industrial Divisions Are Shown in the Order of Their Percentage to Net Income of Total Taxes Paid.

Industrial division	Gross receipts	Total profits before taxes paid	Per cent of profits to gross receipts	All taxes other than federal income	Federal income tax	Total taxes paid	Per cent of other than income tax to profits	Per cent of federal income taxes to profits	Per cent of total taxes to profits	Net profits after deducting all taxes	Per cent of net profits to gross receipts after total taxes paid
Mining and quarrying	$4,876,767,550	$139,447,912	2.86	$99,258,420	$30,777,039	$130,035,459	71.18	22.07	93.25	$9,412,453	.19
Agriculture and related industries	774,423,891	65,438,295	8.45	19,133,271	9,790,743	28,924,014	29.20	15.00	44.20	36,514,281	4.72
Rubber and rubber goods	1,079,780,739	40,483,293	3.75	14,606,350	2,839,675	17,446,025	36.08	7.02	43.10	23,037,268	2.13
Leather and leather products	1,598,608,120	49,010,404	3.08	9,982,565	8,247,672	18,230,237	20.37	16.83	37.20	30,780,167	1.92
Public service, professional, amusements, hotels, etc.	2,420,815,295	181,929,163	7.64	44,763,787	20,376,829	65,140,616	24.21	11.02	35.23	119,788,547	4.95
Transportation and other public utilities	10,560,622,724	1,895,431,923	17.95	474,124,066	150,998,913	625,122,979	25.02	7.96	32.98	1,270,308,944	12.03
Finance, banking, insurance, etc.	8,752,174,665	1,296,464,539	14.82	322,297,327	95,114,379	417,411,706	24.86	7.34	32.20	879,052,833	10.04
Combinations of industries not ascertainable	800,620,301	60,119,141	7.50	11,239,777	5,209,962	16,449,737	18.70	8.66	27.36	43,669,404	5.45
Food products, beverages, and tobacco	10,085,841,519	490,375,027	4.86	72,103,984	55,646,300	127,750,284	14.70	11.34	26.04	362,624,743	3.60
Paper, pulp and products	1,445,827,777	117,936,925	8.15	17,892,023	12,232,699	30,124,722	15.17	10.37	25.54	87,812,203	6.07
Construction	2,226,569,284	88,899,466	4.00	11,000,848	11,438,833	22,439,681	12.38	12.86	25.24	66,459,785	2.99
Trade	32,299,071,061	1,134,667,194	3.51	152,012,085	128,536,444	280,548,529	13.40	11.33	24.73	854,118,665	2.64
Lumber and wood products	2,977,317,109	316,822,497	10.63	38,056,020	33,457,215	71,513,235	12.01	10.56	22.57	245,309,262	8.24
Textiles and textile products	7,869,734,405	574,849,007	7.30	62,942,103	65,435,092	128,377,112	10.95	11.38	22.33	446,471,895	5.67
Metals and metal products	16,633,264,555	1,477,828,375	8.89	165,317,527	160,770,716	326,088,243	11.19	10.88	22.07	1,151,740,132	6.92
Chemicals and allied products	6,121,372,554	508,514,021	8.30	55,447,815	49,426,373	104,874,188	10.90	9.72	20.62	403,639,833	6.59
Miscellaneous manufacturing industries	5,141,792,969	474,640,186	9.23	40,682,774	55,265,523	95,948,297	8.57	11.64	20.21	378,691,889	7.37
Printing and publishing	1,988,459,435	165,207,772	8.31	12,924,646	19,428,950	32,353,596	7.82	11.76	19.58	132,854,176	6.68
Stone, clay and glass	1,366,800,359	189,431,362	13.87	11,244,801	22,113,441	33,358,242	5.93	11.68	17.61	156,073,120	11.42

Data from pages 13, 14 and 15 of "Statistics of Income From the Returns of Net Income for 1923." Included in the net profits are tax-exempt interest and dividends received on capital stock of corporations. Net losses of previous years are not included as it is desirable to have the actual net profits for the year 1923 shown.

neer, who for many years represented a large eastern mining syndicate and who was authorized to secure options upon the most favorable prospects and to spend any reasonable amount of money in their development in order to determine whether his company should buy the property or surrender its option, is authority for the statement that not one in twenty of the prospects carefully selected and properly developed were found good enough after this development to justify the purchase by those whom he represented. This syndicate spent in some instances as much as $100,000 in the development of a single prospect and thereafter surrendered the option because its investigations did not demonstrate that the property was worth the option price to his company.

"The many thousands of dry holes in oil prospecting, the many thousands of idle tunnels and shafts which decorate metal mining regions of the West are conclusive proof of the hazardous character of these enterprises. The great majority of these disastrous developments are not reported to the Internal Revenue Bureau in Washington. Only those companies report which either have made a profit or who might have been supposed to make a profit and, therefore, required to make a tax return.

"The Mining Congress Journal is startled to know the exact facts with relation to the profits earned by those companies which have made tax returns to the Internal Revenue Bureau of the Federal Government. We append a table showing the salient facts with reference to the returns for the year 1923. This table shows that the mining and quarrying industry, which includes oil and coal, paid in state and Federal taxes 93.25 per cent of its total net profits. It shows that after having paid its taxes there remained a net profit of nineteen hundredths of 1 per cent of its gross receipts as a profit, while the agricultural and related industries show a net profit of 4.72 per cent, transportation a net profit of 12.03 per cent, finance, banking, and insurance a net profit of 10.04 per cent. This table shows that the leather and leather products business, with the lowest profit next to mining, earned a profit of 1.92 per cent of its total gross receipts; and yet the net profit of this industry was a little more than ten times as great as the profits of mining, while the transportation industry earned a profit proportionately sixty-three times greater than mining. The mining industry furnishes more than half the total freight tonnage handled by the railroads and pays transportation rates which enables the transportation industry to earn a profit sixty-three times greater and always asking for more.

"In the percentages of these taxes paid to the Federal Government, the mining industry still stands at the head with a percentage of 22.07 per cent, which is approximately twice as great as the average of other branches of industry. In taxation to the state governments from its net profits 71.18 per cent is paid, and yet in the face of this startling condition there are those who believe the mining industry has been escaping its share of public support.

"While the Mining Congress Journal is greatly pleased with the outcome of the present legislative action in the framing of the new revenue act, at the same time we submit that the bill lacks much of doing justice to the mining industry and that in all of the states the mining industry is entitled to more careful consideration by state legislative bodies; and we further submit that since mining is an industry which carries so much of hazard, and which develops so much of new taxable property, the state and Federal legislative bodies should look last to the mining industry for increased revenues rather than compel it to be the first called upon to defend itself against an increase of tax burdens.''

ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Personnel.

There have been no changes of personnel to be noted during the past quarter.

Los Angeles Offices.

On March 7th, the offices of the District Engineer of the State Mining Bureau, also the offices of the Chief Deputy Oil and Gas Supervisor and the Deputy Oil and Gas Supervisor for District 1 under the Department of Petroleum and Gas were removed from the Sun Finance Building, Los Angeles, to the 6th floor of the New Orpheum Building at 846 S. Broadway near 9th street. These offices occupy nearly the entire sixth floor, and are much more commodious and better arranged for efficient operation than our former quarters. There is also a more convenient and ample space for the oil-field peg models, which will allow for future expansion.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Mining in California (quarterly), January, 1926, being Chapter 1 of State Mineralogist's Report XXII. Price 25 cents.

Summary of Operations, California Oil Fields: Vol. 11, Nos. 5, 6 and 7, November and December, 1925, and January, 1926, respectively.

Commercial Mineral Notes: Nos. 35, 36, 37, February-March (inc.). These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale,' issued in the form of a mimeographed sheet, monthly. It is mailed free of charge to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains in addition to its correspondence file and the library, a mine report file which includes reports on some 7500 mines and mineral properties in California.

During the period covered by this quarterly report, there were 6280 letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

Walter W. Bradley, Deputy State Mineralogist.

STATISTICS.

California continues to produce commercially, as for some years past, more than fifty different mineral substances (the number reached a total of 60 in 1924), the total annual value of which for 1925, as shown in the January issue of Mining in California (see page 109, *ante*) was estimated at $422,974,500.

At the present writing (May 1st.), reports are in hand from most of the producers. Data for several substances are now complete and have been compiled, being presented herewith.

Information at hand indicates that there was no production in California during 1925 of the following substances, which have at one time or other in the past been on the active list here: Arsenic, barytes, bismuth, cadmium, fluorspar, graphite, lithia, mica, molybdenum, serpentine, slate, strontium, sulphur, and tin. There was production by a single operator in each, of the following: Andalusite, antimony, asbestos, bituminous rock, calcium chloride, and cyanite, the figures for which will have to be combined under the 'unapportioned' item in the final report. The shipments of cyanite were the first in commercial quantity, of record in California. In addition to the above, there are potential deposits of ores of the following which have not as yet yielded a commercial output: Aluminum, cobalt, nickel, and vanadium.

BORATES.

During 1925 there was produced in California a total of 79,865 tons of borate materials compared with 93,273 tons for the year 1924. The materials shipped in 1925 included crude and selected colemanite ore from Inyo and Kern counties varying from 19% to 30% anhydrous boric acid ('A.B.A'), also crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40% A.B.A. This is approximately the average A.B.A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Re-calculated as above, the 1925 production totals 46,124 tons valued at $1,526,938, a decrease from the similar figures for 1924 which were 52,070 tons and $1,599,149.

CEMENT.

Cement is the most important single structural material in the mineral output of this state. During 1925, there was produced a total of 13,206,630 barrels, valued at $25,043,335 f.o.b. plant. This is an increase of 1,551,499 barrels over the record figure of 11,655,131 barrels in 1924, and an increase of $1,817,530 over the 1924 value of $23,225,850, but still a little short of the record value of $25,999,203 in 1923.

The market in 1925 recovered to some extent from the effect of foreign importations duty-free, which caused the drop in 1924, but the effect had not wholly disappeared.

The 1925 output came from ten operating plants in eight counties, and employing a total of 3166 men. The three plants in San Bernardino County made a total of 5,079,281 barrels valued at $8,828,044, the balance of the state's product coming from a single plant in each of the following counties: Contra Costa, Kern, Riverside, San Benito, San Mateo, Santa Cruz, and Solano. The new plant of the Pacific Portland Cement Company at Redwood City, San Mateo County, began commercial production in 1925. For 1926, the plant of the Calaveras Cement Company has just been completed near San Andreas, Calaveras County, and is now ready to join the producing list.

CHROMITE.

Chromic iron ore, or chromite, to the amount of 591 short tons, recalculated to a basis of 45% Cr_2O_3, valued at $10,912 f.o.b. shipping point, was sold in California during the year 1925. This was largely of ore that had been mined during the World War period but not then sold. It is hoped that the development of the steel industry and the resumption of copper smelting on the Pacific Coast may create some demand for California's chromite, but the outlook for the immediate future is not encouraging.

With reference to the War Minerals Relief bills and their administration in which the chromite producers are particularly interested, under the Shortridge amendment of 1921 and under indirect or published stimulation as distinguished from direct personal demand, there has been paid to claimants principally in western states more than five million dollars; while under the act of March 2, 1919, which has been so construed as to limit recoveries to losses induced by direct personal demand, there has been paid about two million. Certain rejected losses now being litigated are principally in claims under the original act, though there are many claimants qualified under the Shortridge amendment who will be entitled to relief in the event the litigation is favorable to the claimants, or in the event further pending legislation (Oddie's Senate Bill 3641) is enacted.

COAL.

Coal production in California in 1925 totaled 730 short tons valued at $3,880, being credited to Amador, Mendocino, and Riverside counties. Only a small part of it was marketed, as it was mainly consumed for local camp purposes and for power and forge use in development work on the deposits. Considerable development work is under way in Shasta County, as well as in Mendocino. Experiments on a commercial scale are being made by the Pacific Gas and Electric Company with a new type of generator to produce gas from Californian coal at their Marysville gas plant.

DOLOMITE.

The production of dolomite for the year 1925 totaled 42,852 tons valued at $104,900, being an increase in both quantity and value over the 1924 figures of 28,843 tons and $81,271, though less than the record yield of 1923. The 1925 output came from two quarries in Inyo County and one each in San Benito and Tuolumne. The material shipped was utilized for steel-furnace flux and refractories, for manufacture of CO_2, burned dolomitic lime, for stucco dash-coat, and terrazzo.

FULLER'S EARTH.

The production of 5280 tons valued at $91,842 here credited to 1925 as 'fuller's earth' is in reality colloidal clay of the montmorillonite class (sold under such local names as 'bentonite,' 'otaylite,' 'shoshonite,' derived from the locality where found). Because of its being utilized for clarifying, filtering, and cleanser purposes, most of it in petroleum refining, we have placed it for the purpose of the State Mining Bureau's statistical reports, under the fuller's earth heading.

After all, the practical test of a fuller's earth is not so much chemical, as a physical one; that is its physical capacity to absorb basic colors and to remove these colors from solution in animal, vegetable, or mineral oils, also from water.

The 1925 output above noted is a slight decrease in amount from the 5290 tons but an increase in value over the figure of $67,295 in 1924.

GYPSUM.

During 1925, one operator in Imperial County and three in Riverside produced a total of 107,613 tons of gypsum, valued at $172,444, compared with 25,569 tons and $53,210 in 1924 and 86,410 tons worth $188,336 in 1923. The material was utilized mainly in cement manufacture as a retardant, for hard-wall plaster (including wall board), and for fertilizer. The increase over the 1924 figures is due mainly to the larger scale of operations of the Pacific Portland Cement Company's gypsum plant in western Imperial County.

MAGNESITE.

The production of magnesite in California during 1925 amounted to a total of 64,623 tons of crude ore valued at $872,944. Only a small part of it was sold 'crude,' however, as it is practically all shipped in the calcined form. The reports at hand show a total of 28,110 tons shipped calcined, of which 3726 tons was dead-burned and sold for refractory purposes, the balance going to the plastic trade. From 2 to 2½ tons of crude material are mined to make one ton of calcined. The 1925 output is a slight decrease both in quantity and value from the 1924 figures of 67,236 tons crude valued at $900,193. The average of the values reported for 1925 is $13.50 per ton compared with $13.40 in 1924.

The more important producing properties in 1925 were: Maltby No. 1 (Western Magnesite Development Co., operated under lease of C. S. Maltby) on Red Mountain, Santa Clara County; and the Sierra Magnesite Company's group near Porterville, Tulare County; followed in order, by the Sampson Peak Mine (Maltby No. 3), San Benito County; and California Magnesia Company (old Harker Mine) at Porterville. A small amount was also contributed from Stanislaus County.

A preliminary press bulletin by Mr. J. M. Hill of the U. S. Bureau of Mines (Mar. 1, 1926) shows: Imports of magnesite in 1925 were

4429 tons crude, valued at $54,593, most of which came from Italy, 17,102 tons of caustic calcined, valued at $414,734, over half of which came from India, and 47,613 tons of dead-burned, valued at $703,074, practically all of which was from Italy. This was the equivalent of a total of 143,440 tons of crude ore.

MAGNESIUM SALTS.

The production of magnesium chloride and sulphate in California during 1925 totaled 4221 tons valued at $132,553, a slight decrease both in quantity and value from the 1924 figures of 4823 tons and $145,883. This was nearly all chloride, sold for use in magnesite stucco and cement mixtures (Sorel cement), also some for 'road liquor.' It was in part marketed in the liquid form testing 34°-36° Baume, and in part as dry crystals, and was prepared from residual bitterns at salt plants in Alameda, Los Angeles, San Diego, and San Mateo counties. The sulphate marketed was utilized for medicinal and bath purposes.

With the use of magnesite cement and stucco coming more into prominence in building construction on the Pacific Coast, the demand for magnesium chloride is increasing here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

The average value reported for the chloride produced in California in 1925 was approximately $32 per ton, f.o.b. plant.

MANGANESE.

Manganese ore shipments in California in 1925 amounted to a total of 532 tons of all grades valued at $11,500, being a decrease both in quantity and value from the 1924 yield which totaled 1115 tons and $25,785 value. These ores showed analyses of from 45% to 55% Mn, and were utilized by Pacific Coast plants for ferro-manganese.

MINERAL PAINT.

Mineral paint materials were produced in California in 1925 from properties in Stanislaus County, amounting to 669 tons valued at $6,969. This is an increase over the 532 tons and $5,234 of 1924, and was entirely of yellow ochre. Hematite has been shipped from Placer County, and red ochre from Sonoma and Ventura counties in former years.

PLATINUM.

In California platinum is obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Calaveras, Sacramento, Stanislaus, and Yuba counties, with smaller amounts from the hydraulic and surface-sluicing mines of Del Norte, Humboldt, Shasta, Siskiyou, and Trinity.

The production of platinum-group metals in California for the year 1925 totaled 355 ounces, crude, containing 292 fine ounces, valued at $39,937. Of this amount, a total of 307 ounces, crude, or 86%, came from the gold dredges. This is a slight increase over the 273 fine ounces worth $36,452 sold in 1924.

The above-noted total of 292 fine ounces includes 120 fine ounces of iridium, osmiridium, ruthenium, and palladium. Most of the platinum refiners pay for the osmiridium on the basis of its iridium content. Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, osmiridium or iridosmine, with occasionally some ruthenium and palladium. In addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the Mint, but which can not be assigned to the territory of its origin for lack of knowing to which lots of gold it belongs. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

For 1925, the distribution by counties of California's platinum yield was as follows:

Platinum Production, by Counties, 1925.

County	Fine ounces	Value
Butte	[a] 56	$9,177
Shasta	8	725
Trinity	26	3,081
Calaveras, Del Norte, Humboldt, Sacramento,[a] Siskiyou, Stanislaus, Yuba [b] *	202	26,954
Totals	292	$39,937

[a] Includes ruthenium and palladium.
[b] Includes palladium.
* Combined to conceal output of a single operator in each.

POTASH.

During 1925, a total of 36,355 tons of potash salts of all grades was produced in California valued at $829,770, compared with 33,107 tons and $747,407 in 1924. This was entirely of chloride, being mainly from Searles Lake brine, San Bernardino County, but in part from salt-works bitterns at plants in Alameda and San Mateo counties. The quality of the product varied from 45% to 61% equivalent K_2O content; and the material was sold principally for fertilizer manufacture.

PUMICE AND VOLCANIC ASH.

The production of pumice and volcanic ash for the year 1925 amounted to 5319 tons valued at $32,937, and came from properties in Imperial, Inyo, Kern, and Mono counties. This is an increase in tonnage but slightly lower value compared with the 1924 shipments which were 4919 tons worth $33,404.

The material from Imperial County and part of that from Mono is of the vesicular, block variety and was sold for abrasive purposes; the balance of the Mono material and that from Inyo and Kern was the volcanic ash, or tuff variety, and was employed in making soap and cleanser compounds. The Kern County ash is going into the preparation of one of the popular and nationally advertised brands of cleanser compounds.

PYRITES.

A total production of 129,500 short tons of pyrites, valued at $528,550, was reported shipped in California during 1925 from properties in Alameda, Mariposa, and Shasta counties. This was a slight increase both in tonnage and value over the figures of 124,214 tons and $517,835 in 1924.

The material was mostly used in the manufacture of sulphuric acid for explosives and fertilizers, but a portion was utilized directly in the preparation of agricultural fertilizer and insecticide. The sulphur content ranged up to 46.5% S.

QUICKSILVER.

Quicksilver was produced in California in seven counties during 1925 to the amount of 7683 flasks (of 75 pounds, avoirdupois) valued at $621,831, being a slight decrease in quantity but an increase in value compared with the 1924 output of 7948 flasks worth $543,080. This was due to improved prices. The average price received during 1925, according to the producers' reports to the State Mining Bureau, was $80.81 per flask, as against $68.33 in 1924 and the record average of $114.03 for the year 1918.

The average of San Francisco quotations for 1925 was $82.60 per flask, the price ranging without sharp fluctuations between $79.90 and $82.83 from Jan. 1st until the end of October. Beginning with November the quotations advanced sharply to $85.17 and to a maximum of $91.67, closing the year at $90.17. Thus far for 1926, San Francisco quotations have ranged between $88 and $90 per flask. The average of quotations for 1925 in New York was $83.13 per flask.

The above-noted yield of 7683 flasks in 1925 was won from a total of 59,797 tons of ore, being an average content of 9.64 pounds per ton, or 0.482% mercury.

The U. S. Bureau of Mines reports the total production of the United States for 1925 at 9174 flasks valued at $762,616 (using the $83.128 average of New York quotations). Outside of California, the principal yield was from Texas, with a few flasks from Nevada, Arizona, and Idaho. California's contribution was 84% of the total.

The imports of quicksilver in 1925 amounted to 11,245 flasks from Italy and 9754 flasks from Spain, and from all other countries 1782 flasks, making a total of 22,781 flasks. The exports were 204 flasks.

The 1925 quicksilver production in California was distributed by counties, as follows:

County	Flasks	Value
San Benito	6,085	$486,797
Sonoma	351	29,134
Kings, Monterey, Napa, San Luis Obispo, Santa Clara*	1,247	105,900
Totals	7,683	$621,831

* Combined to conceal output of a single operator in each.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

Frank Sanborn, Mineral Technologist.

Comparatively recent research work in the ceramic industries has increased the demand for andalusite, and now the aluminum silicate dumortierite until lately regarded as a mineral of no commercial importance, has come to the front as one having great promises in the ceramic field. When free from certain impurities, dumortierite burns to a pure white and may therefore prove to be a desirable mineral for the better grades of porcelain.

The color of dumortierite is usually a shade of blue or violet-red, but turns white when intensely heated. It is a metamorphic mineral usually found in schists and certain gneisses. In California it is known to occur as large boulders on the plains about twenty-five miles from Ogilby, Imperial County. Samples have also come from Riverside, San Diego and Tuolumne counties.

Samples of andalusite are received occasionally at this bureau, and some of these samples are apparently from newly discovered deposits. Andalusite is now known to occur in Mono, San Diego, San Bernardino, Riverside and Kern counties.

During the four-month period covered by this report 1623 samples were received and determined at the laboratory of the State Mining Bureau. This number is an increase over any previous record, and proves that a great interest is being taken in prospecting for minerals.

LIBRARY.

Forest L. Campbell, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

- Bulletin 781-B—Geology of the Baxter Basin Gas Field, Sweetwater County, Wyoming. By Julian D. Sears.
- Bulletin 780-C—Platinum near Centennial, Wyoming. By F. L. Hess.
- Water Supply Paper 563—Ohio River Basin.
- Water Supply Paper 567—Lower Mississippi River Basin.
- Water Supply Paper 542—South Atlantic Slope and Eastern Gulf of Mexico.
- Water Supply Paper 560—Contributions to the Hydrology of the United States in 1925.
- Water Supply Paper 572—Pacific Basins in Washington and Upper Columbia River Basins.
- Water Supply Paper 552—Pacific Basins in Washington and Upper Columbia River Basin.
- Water Supply Paper 546—Missouri River Basin.
- Professional Paper 146—Mississippian Formations of San Saba County, Texas. By P. V. Roundy, et al.
- Professional Paper 140-A—Geology and Flora of the Latah Formation in Relation to the Lavas of the Columbia Plateau near Spokane, Wash. By J. T. Pardee, Kirk Bryan and F. H. Knowlton.
- Professional Paper 140-C—Pleistocene Plants from North Carolina. By E. H. Berry.
- Professional Paper 140-D—Shore Phases of the Green River Formation in Northern Sweetwater County, Wyoming. By W. H. Bradley.
- Professional Paper 138—Mining in Colorado. By Chas. W. Henderson.
- Professional Paper 140-B—Fossil Proboscidea and Edentata of the San Pedro Valley, Arizona. By James Williams Gidley.

Professional Paper 140-F—Correlation of the Basal Cretaceous Beds of the Southeastern States. By Wythe Cooke.

U. S. Bureau of Mines:

Bulletin 197—Sampling and Examination of Mine Gases and Natural Gas. By G. A. Burrell.

Bulletin 242—Explosion Hazards from the Use of Pulverized Coal at Industrial Plants. By L. D. Tracy.

Bulletin 253—Possibilities for the Commercial Utilization of Peat. By W. W. Odell.

Technical Paper 347—Analyses of Alabama Coals. By Chas. Butts.

Mineral Resources of the United States:

Mica in 1924.

Lead in 1924.

Secondary Metals in 1924.

Lead and Zinc Pigments and Salts in 1924.

Asphalt and Related Bitumens in 1924.

Silver. Copper. Lead and Zinc in the Central States in 1924.

Manganese and Manganiferous Ores in 1924.

Reports of Investigations:

Serial No. 2724—The Disposal of Petroleum Foots Oil. By L. G. Marsh and L. D. Wyant.

Serial No. 2725—Stream Pollution by Acid Mine Drainage. By R. D. Leitch.

Serial No. 2726—Coal-Mining Royalties and Leasing Conditions in Williamson and Franklin Counties, Illinois (District No. VI). By L. D. Tracy.

Serial No. 2727—Boiler Water Conditioning with Special Reference to High Operating Pressure and Corrosion. By Dr. R. E. Hall.

Serial No. 2728—Explosives Used in December, 1925, Including Preliminary Figures for the Year 1925. By W. W. Adams.

Serial No. 2729—Coal-Mine Fatalities in January, 1926. By W. W. Adams.

Serial No. 2730—Experiences With the Combustion of Fuel Oil in Power Plant Boilers. By J. F. Barkley.

Serial No. 2731—Analysis of Copper-Palladium-Gold-Silver Concentrates. By C. W. Davis.

Serial No. 2732—Solubility and Effects of Natural Gas and Air in Crude Oils. By D. B. Dow and L. P. Calkin.

Serial No. 2733—Compensation Insurance Rates as a Measurement of Accident Prevention in Mines. By Byron O. Pickard.

Serial No. 2734—(Withdrawn).

Serial No. 2735—The Value of Leakage Tests in Natural-Gas Transmission Lines. By E. L. Rawlins.

Serial No. 2736—Consumption of Explosives in January, 1926. By W. W. Adams.

Serial No. 2737—Additions, Removals and Changes in Permissible List of Explosives from January 1, 1925, to Devember 31, 1925. By G. St. J. Perrott.

Serial No. 2738—Fatalities in the California Petroleum Industry During the Calendar Year, 1924. By H. C. Miller.

Serial No. 2739—Gases from Blasting in Heavy Sulphides. By E. D. Gardner, G. W. Jones, and J. D. Sullivan.

Serial No. 2740—Thirteenth Semi-Annual Motor Gasoline Survey. By E. C. Lane, H. M. Thorne, and John Devine.

Serial No. 2741—Consumption of Explosives in February, 1926. By W. W. Adams.

Serial No. 2742—Coal-Mine Fatalities in February, 1926. By W. W. Adams.

Information Circulars:

Circular No. 6002—Progress in Use of 1-Inch Steel in the Tri-State Lead and Zinc District. By C. R. Forbes.

Circular No. 6003—The Gasoline Situation. By H. H. Hill.

Arizona Bureau of Mines:

Bulletin 119—A Résumé of Arizona Geology. By N. H. Darton.

Bulletin 121—Field Tests for the Common Metals. By G. R. Fansett.

Georgia Geological Survey: Bulletin 23—Mineral Resources of Georgia. By S. W. McCallie.
Kentucky Geological Survey: Ser. VI. Vol. 27—Mineralogy of Kentucky. By C. H. Richardson.
Nebraska State Museum: Bulletin 10. Vol. 1—Skeletal Parts of the Columbian Mammoth Elephas Maibeni. By E. H. Barbour.

North Carolina Geological and Economic Survey:
  Bulletin 29—The Kaolins of North Carolina. By W. S. Bailey.
  Bulletin 31—Deposits of Brown Iron Ores in Western North Carolina. By W. S. Bailey.
  Bulletin 34—Discharge Records of North Carolina Streams. By Thorndike Saville.
Tennessee Division of Geology: Bulletin 34—Water Resources of Tennessee. By W. R. King.

Canada Department of Mines:
  Report of the Department of Mines for the Year ending March 31, 1925.
  Mines Branch No. 592—Molybdenum, Its Metallurgy and Uses. By V. L. Eardley-Wilmot.
  Investigations in Ceramics and Road Materials.
England Geological Survey: The Water Supply of Wiltshire. By W. Whitaker.
Great Britain Geological Survey: The Concealed Coalfield of Yorkshire and Nottinghamshire. By G. V. Wilson.
  Geology of Berwick on Tweed.
  The Geology of the Country around Stoke-on-Trent.
Mexico Departamento de la Estadistica Nacional: La Riquez de Mexico y El Poder Constructor del Gobierno.
Montevideo, Museo de Historia Natural de: Anales Serie II—Tomo II.

Ontario Department of Mines:
  34th Annual Report, 1925.
    Part 3.
    Part 4.
    Part 6.

  32nd Annual Report, 1923
    Parts 1 to 4.
    Parts 5 to 7.

Scotland Geological Survey: The Geology of Strath Oykell and Lower Loch Sin.
South Australia Department of Mines: No. 42—Mining Review for the half year ended June 30, 1925.
  Royal Society: Transactions and Proceedings. Vol. XLVIII.
  Woods and Forests Department: Annual Progress Report upon State Forest Administration in South Australia for the Year 1924-25.

Societies and Educational Institutions.

University of California: Vol. 16, No. 2—New Canid and Rhinocertid Remains from the Ricardo Pliocene of the Mohave Desert, California. By Chester Stock and E. L. Furlong.
Columbia University: Summer Session Announcement for 1926.
Imperial University of Tokyo, Japan: Journal of the Faculty of Science. Vol. 1, Parts 3 and 4—Geology, Mineralogy, Geography and Seismology.
University of Missouri, School of Mines and Metallurgy: Vol. 9, No. 1—Engineering and Research. By Milo S. Ketchum.
Academy of Natural Sciences, The, Philadelphia: Proceedings, Vol. LXXVII, 1925.
American Philosophical Society: Vol. LXIV, No. 3, 1925.
Mining and Metallurgical Society of America: Bulletin 182.

Books.

The Engineering Index for 1925.

Maps.

Artesia, Calif.
Blacksville, W. Va.-Pa.
Bramwell, W. Va.-Va.
Caruthers, Calif.
Clarksburg, W. Va.
Clarksdale, Mo.
Helm, Calif.
Indian Head, Md.-Va.
Ivanhoe, Calif.
Kahului, H. T.
Long Beach, Calif.
Marion, Ill.
Meadville, Pa.
Memphremagog, Vt.
Raisin, Calif.
Rocky Hill, Calif.
Schrag, Wash.
Stayton, Ore.
Tulare, Calif.
Walton, N. Y.
West Columbus, Ohio.
Whittier, Calif.
Wilmington, Calif.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Bulletin, Union Oil Co., Los Angeles.
California Journal of Development, San Francisco.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical-Engineering and Mining Review, Melbourne, Australia.
Engineering and Mining Journal-Press, New York.
Explosives Engineer, Wilmington, Del.
Financial Insurance News, Los Angeles, California.
Graphite, Jersey City.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mine and Quarry, Chicago.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil and Gas News, Kansas City.
Oil News, Galesburg, Illinois.
Oildom, New York.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, San Francisco, Cal.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of Mining in California was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits ‘wanted’ or ‘for sale’ included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of Mining in California, these lists are now issued monthly in the form of a mimeographed sheet under the title of ‘Commercial Mineral Notes.’

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

41-8 Mine or mill superintendent. Twelve years' experience in west with companies mining copper, lead or zinc and using flotation; can handle either mine or mill. References. Salary open.

41-9 Mining. One year's experience as shift boss. Age 28. Single. References. Salary open.

41-10 Surveyor. One year with Solano County Surveyor. Age 50. Married. Salary wanted, $10 per day. References.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914. Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper	.50
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915—1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California.' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California.' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz counties	.25
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924	Free
January, February, March, April, May, June, July, August, September, October, 1925	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston. 85 pp., 46 illustrations	$0.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps	.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905. 168 pp., 54 illustrations	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905. 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 66. Mining Laws of the United States and California. 1914. 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916. 47 pp.	$0.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted	2.50
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	Free
**Bulletin No. 75. United States and California Mining Laws. 1917. 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring. 1918. 248 pp., 51 illustrations, 5 maps, paper	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley, 1925. 147 pp., 62 photographs, 11 line cuts and maps, cloth	1.00
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916–1917, by R. P. McLaughlin. 1918. 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917–1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan. 1919. 10 photographs, 4 plates, 120 pp., paper	----
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth	1.00

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	$1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley. 1923. 188 pp., paper	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley. 1924. 162 pp., paper	Free
Bulletin No. 95. Geology and Ore Deposits of the Randsburg Quadrangle, by Carlton D. Hulin, 1925. 152 pp., 49 photographs, 13 line cuts, 1 colored geologic map, cloth	2.00
Bulletin No. 96. California Mineral Production for 1924, by Walter W. Bradley. 1925. 173 pp., paper	Free
**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields. December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	----
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

	Price
**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County	$0.25
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County	.25
Register of Oil Wells, with Map, Los Angeles City	.35

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California. Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted	.50
**Unmounted	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	----
**Map of Trinity County	----
**Map of Tuolumne County	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

	Price
Map No. 1—Sargent, Santa Clara County	$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emido and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	1.00
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

O

THE STATE MINING BUREAU

CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE

MINERAL RESOURCES OF CALIFORNIA

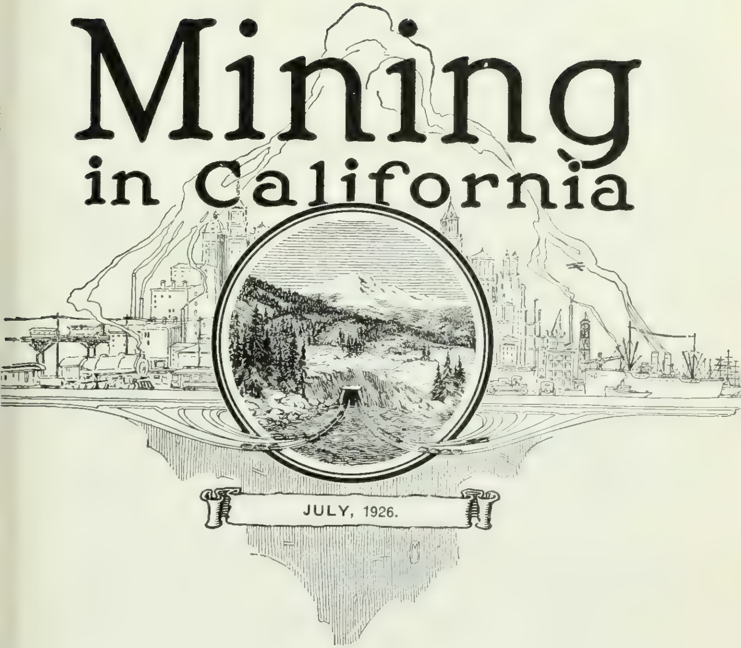
At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the state mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily
Saturday, 9 a.m. to 12 m.

Lloyd L. Root,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.
Branch Offices: New Orpheum Building, Los Angeles; Chamber of Commerce Building (mail address, P. O. Box 1208), Sacramento; Bank of Italy Building, Bakersfield; Taft, Coalinga, Santa Maria, and Santa Paula.

Mining
in California



JULY, 1926.

PUBLISHED QUARTERLY

CALIFORNIA STATE
MINING BUREAU

FERRY BUILDING
SAN FRANCISCO

CALIFORNIA STATE MINING BUREAU

EXECUTIVE AND TECHNICAL STAFF

LLOYD L. ROOT
State Mineralogist

WALTER W. BRADLEY
Deputy State Mineralogist

MINING DIVISION

C. A. Logan, District Mining Engineer	Sacramento
C. McK. Laizure, District Mining Engineer	San Francisco
W. Burling Tucker, District Mining Engineer	Los Angeles
Frank Sanborn, Mineral Technologist	San Francisco
W. F. Dietrich, Ceramic Engineer	San Francisco

DEPARTMENT OF PETROLEUM AND GAS

R. D. Bush, State Oil and Gas Supervisor	San Francisco

Note.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT State Mineralogist

Vol. 22 JULY, 1926 No. 3

CHAPTER OF

REPORT XXII OF THE STATE MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1926

TABLE OF CONTENTS.

PAGE

DISTRICT REPORTS OF MINING ENGINEERS____________ 313

Sacramento Field Division____________ 313

San Francisco Field Division____________ 314

Marin County ____________ 314

Sonoma County ____________ 327

Los Angeles Field Division____________ 365

Oil Field Development Operations____________ 366

SPECIAL ARTICLES ____________ 370

Gas, Gasoline and Petroleum____________ 370

Copper in California ____________ 372

ADMINISTRATIVE DIVISION ____________ 377

DIVISION OF MINERALS AND STATISTICS____________ 378

Statistics ____________ 378

Museum ____________ 386

Laboratory ____________ 387

LIBRARY ____________ 388

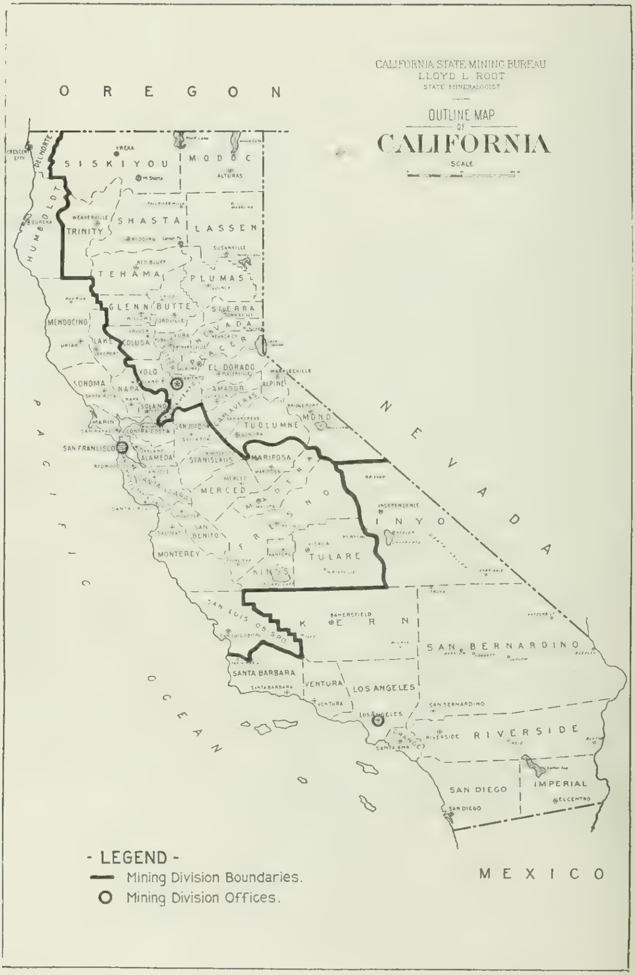
PRODUCERS AND CONSUMERS____________ 395

EMPLOYMENT SERVICE ____________ 396

BUREAU PUBLICATIONS ____________ I

CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST

OUTLINE MAP
OF
CALIFORNIA



PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. Logan, Mining Engineer.

On account of unfinished field work, there is no report from the Sacramento Division in this issue.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

MARIN COUNTY.

Introduction.

Marin is one of the original twenty-seven counties into which the State was divided at the first session of the legislature in 1850. In comparison with most of the other twenty-six original counties, its area was very small. In the intervening years there has been practically no change in its land area, but changes in its southern boundary have slightly increased its water area, and it now comprises a total of 529 square miles. Angel Island and Belvedere Island are a part of Marin County. Its population is 27,342 (1920 census).

Geography and Topography.

Marin County lies north of San Francisco, the Marin Peninsula and San Francisco Peninsula being separated by the Golden Gate. The Pacific Ocean bounds it on the west, Sonoma County and portions of San Pablo Bay and San Francisco Bay surround it on the north and east.

The main line of the Northwestern Pacific railroad runs through the eastern side of the county, and a narrow gauge branch traverses the western portion, passing through Point Reyes and continuing northward into Sonoma County.

Marin County is for the most part rugged and picturesque, the ridges having steep slopes with only a few small flat valleys. The main ridge trends northwesterly, culminating at the south in Mount Tamalpais, which overlooks both bay and ocean from an elevation of 2601 feet. From this main crest the drainage is both to the ocean and bay sides. Other notable topographic features are Tomales, Drakes, Bodega and Bolinas bays on the ocean side and Richardsons Bay on the inland side.

Geology.

The geology of the Marin Peninsula has been described by Lawson[1] and Osmont[2], to which the reader is referred for a detailed discussion.

Geologically, the county is divided into two areas by the great San Andreas fault, which runs in a northwest direction from Bolinas Bay to Tomales Bay. The country lying east of the fault comprises about three-fourths of the county and is composed almost entirely of Franciscan rocks. These include massive sandstone, chert and intrusive bodies of serpentine and basalt. The Point Reyes Peninsula, which includes that portion of the county lying west of San Andreas Fault, is composed mainly of Monterey shale, which is distinctly bituminous in places. Two small areas of volcanic rock are exposed near Inverness and Tomales Point.

Mineral Resources.

The mineralization of the county is diversified but the deposits that may be classed as economic resources are limited, though important on account of their proximity to the metropolitan bay area. The economic minerals are mainly structural and industrial non-metallic products.

---

[1] Lawson, A. C., U. S. Geol. Survey, San Francisco, Folio No. 193.

[2] Osmont, V. C., Bull. Dept. of Geology, University of California, Vol. 4, No. 3.

Occurrences have also been noted of asphaltum, petroleum, chromite, coal, jasper, garnets, manganese, mineral water, and natural gas. A little copper ore was at one time shipped, and traces of gold and silver have been found. Salt has been produced.

At the present time, brick and clay, crushed rock and mineral water are the commercial products. The total recorded mineral production from 1888 to 1925, inclusive, approximates $7,750,000 in value. In 1925 the county's output was valued at $434,802, and the county ranked thirty-fourth in the state. The accompanying table shows the total recorded production from 1888 to 1925, inclusive.

Year	Brick		Miscellaneous stone[1]	
	M.	Value	Tons	Value
1888	1,600	$10,000		
1889	*2,000	12,000		
1890	*5,000	30,000		
1891	*10,000	60,000		
1892	*12,000	72,000		
1893	18,000	108,000		
1894	28,500	172,500		$16,850
1895	29,000	145,000		7,790
1896	15,000	85 000	7,849	8,260
1897	15,000	89,000	6,000	7,200
1898	15,500	66,000	1,710	1,800
1899	16,500	76,000	4,400	5,150
1900	25,000	200,000	3,000	2,500
1901	14,320	100 240	34,000	27,987
1902	14,600	97,700	149,450	105,350
1903	13,819	78,095	144,715	140,332
1904	20,500	132,000	216,576	170,995
1905	22,877	163,585	113,000	44,250
1906	23,900	199,300	54,000	53,000
1907	16,000	118,000	157,100	134,111
1908	10,000	50,000	111,686	66,700
1909	4,500	105,000	132,010	67,010
1910	22,497	99,185	112,000	74,700
1911	19,695	87,445	173,646	108,786
1912	18,000	88,200	5,300	3,000
1913	16,000	70,500	428,357	198,953
1914	15,000	55,000		490,137
1915	10,000	50,000		101,528
1916	[2]			74,000
1917	[2]			158,582
1918	[2]			89,458
1919	[2]			127,111
1920	[2]			208,302
1921	[2]			202,333
1922			[2]	[2]
1923	[2]			516,936
1924	[2]			356,035
1925	[2]			214,602
Totals	[2]434,808	$2,619,750		[2]$3,813,748

*Estimated.
[1] Includes crushed rock, rubble, rip-rap, sand, gravel
[2] See under 'Unapportioned.'

The mineral deposits have been described in detail in various early reports of the State Mineralogist; the most recent complete data on the county being contained in Report XIV, 1913-14. In order to bring these data up to date, the county was visited in August, 1926, and all new developments noted are included in this revision.

ASPHALTUM.

Along the shore-line cliffs west of Bolinas, from Duxbury Point north for a distance of over three miles, there are several small occurrences of asphaltum in Monterey shale. These appear to be residues from oil seepages. The shale strata strike southeast and dip to the west at an angle of 45° to 50°. At Duxbury Point the shale beds are massive and continue for some distance into the sea, forming the well-known Duxbury Reef. In the cliffs at this point the asphaltum occurs in thin seams cutting across and nearly normal to the dip of the strata. The deposits, as a whole, are small and unimportant.

Bibl: State Mineralogist's Reports XIV, p. 249; XIII, p. 36; XIV, p. 241.

1888-1925.

Mineral water		Miscellaneous and unapportioned		
Gallons	Value	Amount	Value	Substance
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	7,000 cu. ft	$5,000	Granite
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	700 tons	1,400	Salt.
----	----	----	----	
----	----	----	----	
----	----	----	----	
----	----	150 tons	300	Salt.
----	----	----	----	
52,000	$12,050	----	----	
47,500	5,075	----	42,000	Unapportioned. 1900-1909.
100,000	10,000	----	----	
328,740	36,500	----	----	
260,000	31,000	----	----	
60,000	9,000	----	----	
60,000	9,000	----	----	
60,000	9,000	----	----	
[2]	----	----	74,000	Brick and mineral water.
[2]	----	----	113,720	Brick and mineral water.
[2]	----	----	86,725	Brick, copper, gold, mineral water, silver.
[2]	----	----	101,863	Brick and mineral water.
[2]	----	----	127,443	Brick and mineral water.
[2]	----	----	116,443	Brick and mineral water.
[2]	[2]	----	403,099	Brick, mineral water, potash, miscellaneous stone.
----	----	----	171,945	Brick, clay, mineral water.
----	----	----	171,196	Brick, pottery clay, mineral water.
[2]	----	----	190,200	Brick, clay and mineral water.
[2]962,240	$121,625	----	$1,605,334	

BRICK AND CLAY.

Clay products, notably common bricks, have been produced in this county since 1870, but no records of output before 1888 are available. Three plants have been located here in the past. One plant at present is steadily producing.

McNear Brick Company. E. B. McNear, president; home office, 417 Berry Street, San Francisco. This plant is on tidewater at McNear's Point, four miles east of San Rafael, which is the nearest railroad shipping point. Most of the product is shipped by barges to various bay points. Bricks have been made here for many years and the clay and shale now have to be transported a considerable distance to the plant. The clay and shale deposits overlay Franciscan metamorphic sandstone which forms the body of the hills. Blasting is occasionally required and electricity is used for detonating the charges. An electrically operated dragline scraper brings the loose material to a loading hopper from which it is drawn into cars. These are hauled to the brick plant in trains of four cars each by a Baldwin Westinghouse-equipped electric locomotive, discharging to storage bins. The 'dry-pan process' is used and after crushing and screening, the dampened clay is fed to the pug-mill and auger stiff-mud machine. A wire brick-cutter cuts the bricks to proper size and they are discharged on to a belt conveyor. The 'green' brick are taken from the belt and stacked on trucks and trammed to the storage sheds. A small hand-operated jack lifts the entire load, cross pieces are slipped under, permitting it to rest on the drying-rack, and the truck is then withdrawn and returned for another load.

The brick-forming end of the plant has a capacity in excess of the kilns and this excess is stored for burning in the winter. The plant has an annual capacity of 20,000,000 bricks. There are two Hoffmann continuous kilns.

The Hoffmann kiln consists of an arched, tunnel-shaped, firing chamber, either circular or oval in plan, or of two parallel tunnels joined by circular ends. The furnaces at the McNear plant are of the last-named type. This produces an endless kiln capable of being subdivided into a series of chambers of nearly equal size by means of cross partitions of a temporary character. From each chamber three flues lead respectively to: the central stack; the chamber preceding it in the series; and the chamber following it. Each of these flues may be closed at will by the insertion of a partition of sheet iron. Each compartment also has a doorway connected with the outside for charging and discharging. Slack or other fine coal is fed in at the top of the chambers and one chamber is fired. The flues leading to the stack are closed except that from the newest chamber charged, behind the one fired. The interchamber flues are left open except the one between the fired chamber and that behind it in the series. By this arrangement the hot gases from the fired chamber pass successively through the other charged chambers, finally passing out from the last one to the central stack. When the bricks in the fired chamber are sufficiently burned, it is allowed to cool by closing its flues, and the next chamber

Clay and shale deposit of McNear Brick Company, showing loading hopper. Marin County.

ahead is fired. After removing the burned bricks the compartment is recharged and its flues opened *to* the stack and *from* the chamber behind it.

A barge load of oil coke, a cheaper fuel than coal, is being tried out at present, and promises to give satisfactory results. From 45 to 50 men are employed.

Bibl: State Mineralogist's Reports VIII, p. 342; XII, p. 382; XIII, p. 615; XIV, p. 244. Bull. 38, p. 249.

Patent Brick Company. A former plant at Gallinas Station on the Northwestern Pacific Railroad has been dismantled, and this company is out of business. The *Hidecker Brick Co.*, 24th and Union streets, Oakland, occasionally crushes some of the old brick at this place for roofing material.

Bibl: State Mineralogist's Reports XII, p. 382; XIII, p. 615; XIV, p. 247. Bull. 38, p. 250.

Remillard Brick Company. This company's former plant at Green Brae has been dismantled for about 15 years.

Bibl: State Mineralogist's Report VIII, p. 342; XII, p. 382; XIV, p. 248. Bull. 38, p. 250.

Louis Sbarbori, 554 Broadway, San Francisco, has recently leased the Remillard property and will begin the manufacture of floor tile as soon as machinery is installed. Production is expected to start in about six months.

Common red-burning clays appear to be fairly abundant in the county but none is utilized at present except that at the McNear Brick Company's plant. Good clay, from which pottery was made on a hand scale at one time, is reported to occur on the Bothin tract near Fairfax. Kaolin has been found near Duncan Mills. Clay deposits also are found on the old Maillard Ranch, now owned by the Lagunitas Development Company, 833 Market Street, San Francisco.

Bibl: State Mineralogist's Reports V, p. 108; XI, p. 253; XII, pp. 329, 382; XIII, 506; Bull. 38, p. 362.

CHROMITE.

No commercial deposits of chrome ore are known within the county, but there are reported to be small occurrences on the Maillard Ranch, now owned by the Lagunitas Development Company, 833 Market Street, San Francisco, and included in their subdivision at Woodacre.

COAL.

There is a specimen of lignite in the museum of the State Mining Bureau from the Barton Ranch on Tomales Bay; and a small broken vein of coal—a shaly lignite—was found in the Escalle Quarry at Escalle Station.

Bibl: State Mineralogist's Reports XI, p. 251; XIV, p. 248; U. S. Geol. Survey Min. Resources, 1891, p. 214.

COPPER.

In 1863 two or three companies did some work on a series of copper prospects about a mile east of Woodville (then Dogtown), north of Bolinas, and a small tonnage of sorted ore was shipped for treatment.

The Bolinas Copper Mining Company, T. P. H. Whitelaw, manager, in 1900 shipped some copper ore from the same locality, but nothing has been done since.

Bibl: State Mineralogist's Reports V, p. 98, XI, p. 253; XIII, p. 59; XIV, p. 248; Bull. 20, p. 14, Bull. 50, p. 168.

Some nice specimens of copper ore have been obtained and several are on exhibit in the State Mining Bureau museum, but it is not believed that the deposits are extensive enough to be classed as an economic resource of any importance.

GEM MATERIALS.

Garnets occur in mica schist near California City on the Tiburon Peninsula. The most common variety is andradite, a lime-iron garnet.

So-called moonstones (principally translucent quartz) are found as pebbles along the ocean beach. They are especially abundant near Bolinas Point.

Jasper occurs quite plentifully in Marin County, associated with Franciscan cherts. Dr. S. M. Augustine, of Berkeley (formerly a resident of San Rafael), made a large and beautiful collection of polished specimens of red and yellow jasper and banded chalcedony from around San Rafael, Sausalito, and other parts of Marin County. It makes beautiful jewelry but is too expensive to collect and prepare. It is highly siliceous and very hard, but is not obtainable in large enough pieces for building decoration. There is an infinite variety of coloring and figures.

Bibl: State Mineralogist's Report XIV, p. 249; Bull. 37, pp. 52, 78; Bull. 38, p. 366; Bull. 91, p. 88.

MAGNESITE.

Magnesite occurs at Woodacre on the property of the Lagunitas Development Company, 833 Market Street, San Francisco. It is said to have been investigated during the war period and found not to be of commercial value.

MANGANESE.

Manganese in the form of psilomelane is found on the Maillard Ranch, one-half mile south of Woodacre, a subdivision owned by the Lagunitas Development Company, 833 Market Street, San Francisco. It occurs as stains and irregular masses in red jasper. The manganese is high in silica and, though investigated with a view to working during the late war period, the deposit was never developed, and probably is too low grade to be marketable.

About one mile west of Sausalito Point manganese oxides occur, associated with massive jasper. The material is mostly of low grade, but one streak of fine ore, 15 inches in thickness, could be traced about six feet.

Another deposit was exposed in a road cut near Fort Baker and was described by A. C. Lawson[1] as follows: "The manganese is well exposed as a stratified deposit of hard, clean psilomelane about 18 inches thick, grading off in its upper part to a lean ore consisting of chert and shale highly charged with the black manganese mineral. There is no definite boundary between this lean ore and the normal radiolarian cherts, for the proportion of psilomelane simply decreased till it ceases to color the rock. The thickness of the ore-impregnated cherts above the layer of psilomelane is about 12 feet. This body of ore lies within a few feet of an intrusive contact of ellipsoidal basalt with the cherts, the contact plane being parallel to the bedding, and may be traced for 90 feet on the outcrop of the formation, which dips about 40 degrees southwest. In several samples taken by D. C. Billick, the psilomelane contains gold not exceeding 40 cents to the ton."

MINERAL WATER.

There are several small mineral springs in the county, some of which are not improved or utilized; mineral water, however, has been one of Marin County's commercial products for nearly 20 years.

Ancha Vista Hotel Spring. Dave Davis, owner, San Anselmo. This spring is in sandstone on the slope of Red Hill at San Anselmo; elevation 150 feet. It has been known for over 40 years, but utilized medicinally for the last 15 years only. An analysis is reported to show 21 grains per gallon, principally magnesia and lithia. The flow is about 100 gallons per day. It is used for drinking only. None is bottled.

Bibl: State Mineralogist's Report XIV, p. 249.

El Toro Spring. This is a mildly sulphurated spring on the Taylor Ranch, 2½ miles northwest of Novato. The water was bottled at one time, but it is not utilized at present.

Bibl: State Mineralogist's Report XI, p. 251; XIII, p. 512; XIV, p. 250; U. S. Geol. Survey Water Supply Paper 338, p. 255.

Rocky Point Hot Sulphur Springs. This is a warm, mildly sulphurated spring on the beach, about six miles northwest of Point Bonita. It is exposed only at low tide.

Bibl: State Mineralogist's Reports XI, p. 250; XII, p. 512; XIV, p. 250; U. S. Geol. Survey Water Supply Paper 338, p. 80.

Tamalpais Mineral Water Spring. Borello Bros., owner. This is a drilled well at First and Hayes streets, San Rafael; elevation 50 feet (U. S. G. S.). The well was sunk in 1903, and the water analyzed in December, 1904, followed immediately by bottling operations. It is 26 feet deep, not artesian, and has no contained gas. It is bottled, carbonated, and is also used in the manufacture of soda water and other flavored soft drinks. Temperature 60° F. A 3-h.p. electric motor runs the pump and bottling machines.

Bibl: State Mineralogist's Report XIV, p. 250; U. S. Geol. Survey Water Supply Paper, 338, p. 307.

---

[1] Lawson, A. C., U. S. Geol. Survey San Francisco Folio, No. 193, p. 23.

Woodacre Iron Spring. On the property of the Lagunitas Development Company (formerly the Maillard Ranch) at Woodacre. Not utilized.

NATURAL GAS.

An inflammable gas escapes from the reef at Duxbury Point, near Bolinas. It can be observed only at extreme low tide. It is stated that natural gas has also been detected near Nicasio.

Bibl: State Mineralogist's Reports VII, p. 184; XIII, p. 567; XIV, p. 250.

PETROLEUM.

The possibilities of obtaining commercial quantities of oil in Marin County were investigated by Vander Leck[1] and are discussed in Bulletin No. 89 (out of print). His conclusions are given as follows:

"The country lying west of the San Andreas Fault is called the Point Reyes Peninsula and as a result of being on the downthrow side of the fault rocks of Miocene and Pliocene age are found exposed in this district.

"These formations consist of bituminous shale of the Monterey formation and loose marine sands of the Merced formation (Lower Pliocene).

"The Monterey shales cover about nine-tenths of the peninsula. In the northern portion near Inverness and Tomales Bay they rest directly on the granitic rocks. At Bolinas Point and Duxbury Reef the shales are distinctly bituminous and there are small seepages of heavy black oil at both of these localities. Due to the close proximity of the shales to the fault zone, they have been intensely folded and crushed, which obscures the true nature of the structure. However, there are at least two well defined anticlines on the peninsula as well as numerous minor folds. The axis of the most westerly fold may be seen along the beach one-half mile west of the town of Bolinas where it strikes N. 30° W. The axis of the second fold runs along the high ridge about one-half mile west of Pine Gulch and Olema Creek. This strikes in a general northwest direction. The total thickness of the Monterey in this area is about 4000 feet. The Merced sands occupy a small area in Paradise Valley, just north of the town of Bolinas. The total thickness of these sands is about 600 feet and the general dip is about 30° to the east. Ordinarily it would be expected that these sands would be petroliferous, as they overlie the bituminous shale; this is not the case, however, as they show no evidence of any oil content. This lack of oil is probably due to the great unconformity between these beds and the Montery shale. Three wells have been drilled just west of the town of Bolinas on the Garzolia Ranch. Two of these were drilled about one-fourth of a mile west of the ranch house at the head of a small gully. These wells were drilled to a depth of about 1800 feet in the Monterey. The one nearest the ranch house encountered no oil; the one nearest the ocean had a small showing at 700 and 1200 feet. A third well was drilled on the sea cliff just back of Duxbury Reef. This well went into the Monterey for 2800 feet and encountered small showing at 200 and 2400 feet. These wells were drilled about 1905.

"The possibility of obtaining oil in commercial quantities in this district is not very good. The Upper Miocene sands which once probably overlayed the Monterey shale and in which the oil content of the shales probably collected have been removed by erosion. Such oil as remains is in small quantities in fractured zones in the shale and it is doubtful if anything more than a showing would be encountered in any well drilled in this area."

"Both the character and age of the rocks in the country lying east of the fault preclude their being oil-bearing, and this district may be dismissed as having no oil possibilities."

SALT.

Salt was first made from the bay water by evaporation at San Rafael in 1867. More recently the Golden Gate Salt Company reported an output for a time, but there has been no plant in operation since 1909.

Bibl: Bull. 24, p. 106.

---

[1] Vander Leck, Lawrence, Petroleum Resources of California, State Mining Bureau Bull. No. 89, pp. 35-36.

STONE INDUSTRY.

Rubble and crushed rock have accounted for a large proportion of the mineral output of the county, and they will probably continue to be among its chief mineral products. Some 15 quarries are described by name in State Mineralogist's Report XIV, 1913-14, about half of which were operating, at least intermittently, at that time. There are now two large rock-crushing plants, and practically all other quarries are idle. Those not active will be only briefly mentioned.

Daniel Contracting Company (Bull Quarry, also McNear Quarry). Home office, 503 Market Street, San Francisco; John H. Hopps, vice president and general manager. This company operates on a large scale on land owned by the McNear Company, Inc., at Point San Pedro, six miles east of San Rafael. The property now includes the adjoining quarry formerly operated by the San Francisco Quarries Company, and the quarry face is extensive. There are three stiff-leg derricks for handling rubble and two traveling cranes of seven to ten tons capacity. A new loading derrick for crushed rock is being constructed. Practically all material is shipped by barge. Shovel equipment includes 2-70's and 1-65 Bucyrus oil-fired steam shovels and 1-M37 Marion electric. There are two American, two Porter, one Vulcan and three Davenport steam locomotives, 51 side-dump cars, 14 small flats (1 pair of trucks) and 12 large flat cars (2 pair of trucks). The crushing plant contains a 48-inch by 60-inch primary jaw crusher, a No. 8 McCully secondary crusher, two 48-inch and one 24-inch Simonds disc crushers. The standard sizes of crushed rock produced are: No. 4, $\frac{1}{8}''$-$\frac{3}{4}''$; No. 3, $\frac{3}{4}''$-$1\frac{1}{4}''$; No. 2, $1\frac{1}{4}''$-$2\frac{1}{2}''$. None of the material is washed. The rock is mostly a hard, bluish-gray Franciscan metamorphic sandstone.

In blasting, heavy charges are used. The last combination shot required 455 feet of tunnel and 2500 feet of 6-inch holes. Fifty-five tons of explosive were used, 20% of which was 60% dynamite and the remainder 40% to 10%. The 10% explosive was loaded in the tunnel and the 40% and 60% dynamite in the holes. After the blast it was estimated that there were 168,000 tons of broken rock in front of the blast and a total of 300,000 tons broken. The capacity of the plant is 1200 tons per day. Electric power is used for the compressors and crushing department, the connected load being 680 horsepower. Forty-eight men are employed.

Bibl: State Mineralogist's Report XIV, p. 250; Bull. 38, p. 318.

Escalle Quarry. A small quarry in a ravine at Escalle Station. Idle.

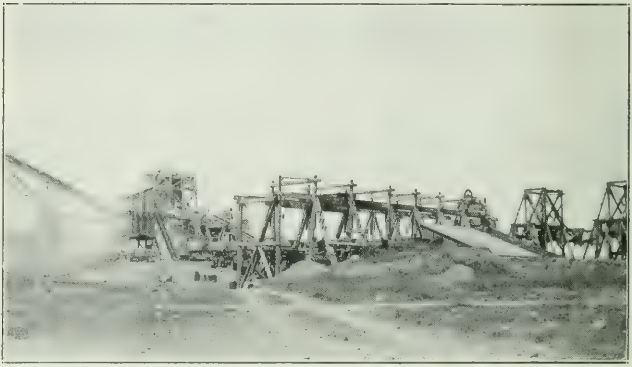
Bibl: State Mineralogist's Report XIV, p. 254.

Forbes Quarry. A red chert quarry at the north edge of San Rafael. Idle.

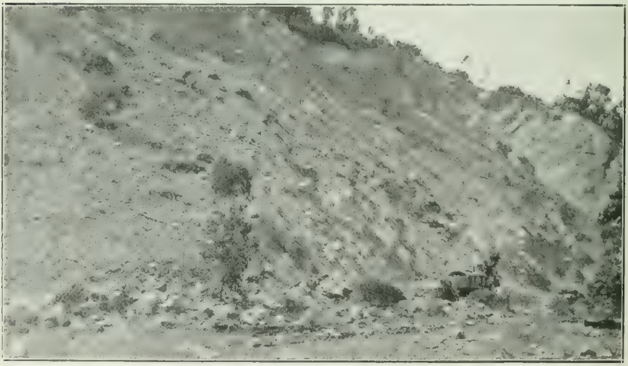
Bibl: State Mineralogist's Reports XII, p. 389; XIII, p. 625; XIV, p. 254; Bull. 38, p. 318.

Fort Baker Quarry. U. S. Government, owner. It was in active operation during the building of the Panama Pacific Exposition, but has been idle since then. The rock is a dark, fine-grained, greenish and brown metamorphic sandstone.

Fort McDowell Quarry (Angel Island Quarry). U. S. Government, owner; Quartermaster at Angel Island, in charge. This quarry has furnished a large amount of rock for construction work at Fort Mason, the Presidio, and Alcatraz Island. The last operation on a large scale was for harbor work at Point Richmond in 1922. There is a crushing plant here which is operated as occasion demands, the material now being used for making concrete poles and on the roads.



Crushing plant at Daniel Contracting Company's quarry, Point San Pedro, Marin County.



Quarry face at Daniel Contracting Company's quarry, Point San Pedro, Marin County, showing result of recent large blast.

Bibl: State Mineralogist's Report XIV, p. 254.

Hoffman Quarry. A small quarry, three miles north of San Rafael. Idle.

Bibl: State Mineralogist's Report XIV, p. 255; Bull. 38, p. 319.

Hotaling Quarry. At the south end of Clark Street, San Rafael. Idle.

Bibl: State Mineralogist's Reports XII, p. 389; XIII, p. 625; XIV, p. 255; Bull. 38, p. 319.

Hutchinson Company, Inc. (Green Brae Quarry; Quarry No. 3). Home office, 1706 Broadway, Oakland; Dwight Hutchinson, president; H. Hardy, secretary. The Green Brae quarry of Hutchinson Company, Inc. was opened up in July, 1925, and crushed rock output began in March, 1926. The property comprises 200 acres covering hills composed of hard metamorphic sandstone, adjacent to Green Brae Station on the Northwestern Pacific Railroad and tide water.

The quarry at present is an open-cut, but a tunnel is now being driven into the hills and glory-hole operations will be carried on from it. In the open-cut workings, 22-foot toe holes are put in with air drills. After shooting, the broken rock is picked up by two Erie oil-fired steam shovels, with 1¼-yard buckets and loaded into automatic side-dump cars of 4- and 5-yard capacity. Two Plymouth gasoline motors haul the rock in trains of four cars each to the primary crusher bin. The primary is a Buchanan 36-inch by 42-inch jaw crusher. The discharge is carried by a 36-inch belt to two No. 7½ Allis Chalmers gyratory crushers. A scalping screen is being installed between the primary and gyratory crushers, but is not yet in use. The product of the No. 7½ gyratory crushers passes by a 30-inch belt conveyor to the screens. There are two revolving trommels and two Link-Belt screens. Oversize from the trommels goes to two No. 6 gyratory crushers and their discharge to No. 2 conveyors. Practically any size can be produced, the standard sizes being Macadam (No. 2), 1¼″-2¾″; Concrete (No. 3), ¾″-1¼″; Screenings (No. 4), ¼″-¾″; Birdseye, ¼″; rock dust; crusher run (mixed) and rubble rock. Chutes from the storage bins are arranged for loading trucks or railroad cars, a spur track running to the plant. A 500-foot 30-inch belt conveyor equipped with an automatic Merrick Conveyor weightometer delivers from any bin to barges for water transportation. The yard storage is handled by a Brownhoist steam crane with 1¼-yard bucket mounted on railroad trucks.

Electric power, furnished by the Pacific Gas and Electric Company, is used, the connected load being 700 horsepower. The plant has a capacity of 1600 tons per day. Forty-five men are employed.

Bibl: Explosive Engineer, August, 1926.

Marin Rock Company. Formerly operated a quarry on the west edge of San Anselmo. Out of business.

Bibl: State Mineralogist's Report XIV, p. 255.

Northwestern Pacific Railroad Company. Intermittently operates quarries at Black Point, Tiburon Point, Waldo, and other localities for ballast and fill.

Bibl: State Mineralogist's Report XIV, p. 256; Bull. 38, p. 319.

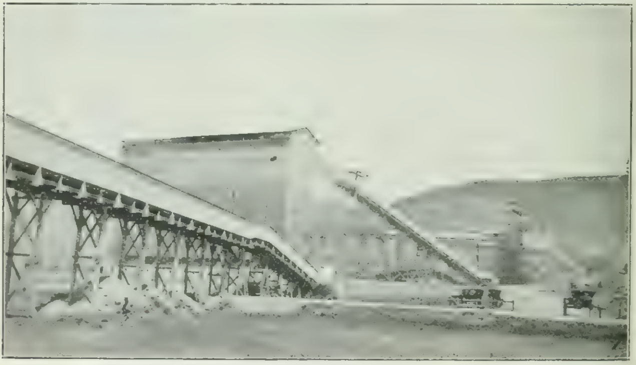
Point Bonita Quarry (Fort Barry). U. S. Government, owner. Idle since 1917. A second quarry was opened here and operated for a few years, but has been idle since 1920.

Bibl: State Mineralogist's Report XIV, p. 256.

San Francisco Quarries Company. This quarry is now a part of that of the Daniels Contracting Company.

Bibl: State Mineralogist's Report XIV, p. 258; Bull. 38, p. 319.

Open cut at Green Brae Quarry of Hutchinson Company, Inc., Marin County.



Crushing plant of Hutchinson Company, Inc., at Green Brae quarry, Marin County. The conveyor in foreground discharges to barges on tide water.

Short Ranch Quarries. Owned by Bennett and Croker, San Anselmo. The rock is a blue metamorphic sandstone. Operated intermittently. Idle.

Bibl: State Mineralogist's Report XIV, p. 260.

SONOMA COUNTY.

C. McK. Laizure, Mining Engineer.

Introduction.

Sonoma is one of the original counties created in 1850. At that time its northern boundary was described as follows[1]: "Beginning at the sea coast at the mouth of Russian River and following up the middle of said river to its source in the range of mountains called Mayacmas." The eastern and southern boundaries were practically the same as they are today except that Mare Island, Solano County, was at first included in Sonoma. A number of changes were later made in the northern boundary and eventually the area north and west of Russian River, as far as the present Mendocino line, became part of Sonoma County. These changes cut off from Sonoma that portion east of Russian River and north of the present Mendocino County line. As now defined, Sonoma has a land area of 1577 square miles. Its population is 51,990 (1920 census).

Geography and Topography.

Sonoma County is situated north of Marin County and San Pablo Bay, extending eastward from the Pacific Ocean, which it borders for 50 miles, to the crest of the Coast Range, which forms the boundary separating it on the east from Lake and Napa counties. Mendocino County bounds it on the north. There are no improved harbors on the coast side, but water shipping facilities are available in the southern portion, which borders the bay. The Northwestern Pacific Railroad traverses the county from south to north through the central valley, with branch lines into Sonoma Valley, to Sebastopol and to the Russian River region around Guerneville, Duncan Mills and Cazadero. A narrow-gauge branch also extends from Marin County northward through Valley Ford to Monte Rio in the western part. A line of the Southern Pacific Railroad from Napa Junction in Napa County traverses the Sonoma Valley and terminates at Santa Rosa. The Petaluma and Santa Rosa electric system also gives service to the southern portion of the county. The paved 'Redwood Highway' of the State system closely parallels the Northwestern Pacific Railroad through the county. Its main laterals are also paved or well-kept graveled roads.

The county produces a great variety of agricultural products but especially prunes, apples, grapes, pears, and other fruits; poultry raising and egg production are highly developed industries and dairying and stock-raising are important sources of wealth. Its mineral deposits have been exploited more or less continuously since the sixties, and although it can scarcely be classified as a 'mining' county, metals and non-metallic minerals exceeding 11 million dollars in value have been produced to date. Its resources are still far from exhausted.

Many health-giving mineral springs are found here, and its resorts have made the county one of the favorite playgrounds of central California.

Situated in the midst of the Coast Range, its topographic features include level valleys, low rolling hills and rugged mountains, with deep-cut canyons. The drainage of the southern portion is to the bay, while that of the northern two-thirds is to the Pacific Ocean, chiefly by the Russian River and its tributaries. The main valley area, beginning at the bay, extends through the center of the county for about 60 miles, with an average width of 25 miles, but narrowing toward the northern end. Numerous smaller valleys separate the lesser spurs and ridges of the main range.

---

[1] Coy, Owen C., California County Boundaries, California Historical Survey Commission, Berkeley, 1923.

Geology.

Sonoma County is not covered by any of the United States Geological Survey Folios and the geologic literature on this area is fragmentary. The general geology has been described in part by Osmont[1]; and by Vander Leck[2], in its relation to possible oil production. The geology of the quicksilver ore deposits has also been covered in considerable detail by various writers.

As shown on the State Mining Bureau's geological map of the state, the Franciscan rocks of the Coast Range cover probably three-fourths of Sonoma County, extending in a broad belt from the Marin County line northwesterly the entire length of the county and beyond. This belt of metamorphic rocks widens toward the north. It consists mainly of sandstone, with smaller amounts of limestone, slates, cherts, schist, and much serpentine. Bordering the coast from Salmon Creek north, is a belt of Cretaceous sandstone and shale a few miles in width. Tertiary sedimentary rocks are exposed in a small area around Valley Ford. The main valley area is composed of Quaternary sands, gravels, and clays along the Russian River from Cloverdale to Healdsburg. These formations narrow at Windsor and then widen again between Forestville and Santa Rosa and continue south through Sebastopol and Cotati nearly to Petaluma. The lowlands area around the mouth of Petaluma Creek and Sonoma Creek is also of Quaternary age. Most of Sonoma Valley, the Sonoma Hills and the area surrounding Santa Rosa on the east and north is made up of Tertiary sediments consisting of fine and medium sands, clay and shale. Late volcanic lavas cover a considerable area in the neighborhood of Mount St. Helena. They also appear along the eastern boundary of the county, on the west side of Sonoma Valley, and near Petaluma. The lavas are mainly andesitic, but in places grade into basalt. Volcanic tuffs are found interbedded with the Tertiary sediments at many points.

Mineral Resources.

Sonoma County has contributed to the mineral output of the state since prior to the sixties. The earliest segregated county records, however, do not begin until 1873. Its resources embrace a varied list of products, both metallic and non-metallic. The output of some of these materials has been practically continuous since it began; others have been produced for a time only and then operations have ceased as economic conditions have changed.

Commercial production has been made of quicksilver, miscellaneous stone, brick and clay, mineral water, mineral paint, magnesite, graphite, lime, diatomaceous earth, gems, chromite, and manganese. To the list may now be added petroleum. Occurrences are also known of arsenic, coal, sulphur, cobalt, copper, gypsum, gold, pyrite, stibnite, iron, zircon and onyx. Besides these, fully a dozen other mineral species not commercially used have been reported.

---

[1] Osmont, V. C., A Geological Section of the Coast Ranges North of San Francisco, Bull. Dept. of Geol., University of California, Vol. 4, No. 3, pp. 39-87.

[2] Vander Leck, Lawrence, Petroleum Resources of California, State Min. Bur. Bull. 89, pp. 36-38.

The recent discovery of a new mineral, Curtisite, is of academic interest.

The drilling of natural-steam wells at The Geysers in this county is probably the most unusual power development activity in the United States, its latent capacity being measureless.

The last general report on the mineral resources of Sonoma County is contained in State Mineralogist's Report XIV, 1913-14. A few additional data are contained in Report XVII, 1920. The quicksilver mines are described in detail in Bulletin No. 78, 'Quicksilver Resources of California,' 1918. Bulletin No. 79, 'Magnesite in California,' includes the deposits here, and Bulletin No. 76 covers the chromite and manganese occurrences. The possibilities of petroleum production are discussed in Bulletin No. 89, 1921 (out of print). Although previously published reports are fairly complete, in order to bring these data up to date in conformity with the new series of county reports begun in State Mineralogist's Report XXI, 1925, the county was visited in August, 1926, and all new developments and changes in the status of the industry that came to the writer's attention are included herein.

As the deposits of quicksilver, manganese, chromium and magnesite are covered in detail in the special bulletins mentioned, which are still available, extended descriptions in this report would be a useless repetition.

The accompanying table gives the total recorded mineral output from 1873 to 1925, inclusive. In 1925 the output was valued at $160,231 and the county ranked forty-fourth among the 58 counties of the State.

SONOMA COUNTY.

Year	Quicksilver		Mineral paint		Brick	
	Flasks	Value	Tons	Value	M.	Value
1873	50	$4,017				
1874	1,700	178,806				
1875	1,218	102,495				
1876	3,897	171,468				
1877	3,609	134,616				
1878	3,255	106,890				
1879	2,977	88,923				
1880	1,445	44,795				
1881	1,273	37,974				
1882	2,124	59,960				
1883	1,669	47,984				
1884	332	10,126				
1885	446	13,715				
1886	735	26,093				
1887	689	29,196			1,000	$5,000
1888	1,151	48,918			1,000	5,000
1889	1,345	60,525				
1890	1,046	54,915				
1891	1,660	75,115				
1892	1,630	66,357				
1893	1,445	53,104				
1894	1,368	41,998	100	$3,500	375	1,875
1895	1,813	70,707	225	3,375	350	1,750
1896	1,126	37,150	220	3,740	250	1,250
1897	1,538	59,982	270	3,780	[1]300	1,500
1898	1,704	63,048			350	2,800
1899	2,119	105,950			200	1,800
1900	2,209	99,500			280	2,360
1901	2,130	95,850			150	1,200
1902	1,440	64,685	30	105	150	1,200
1903	2,404	98,676	800	320	160	1,440
1904	[4]2,700	102,829			175	1,750
1905	2,504	97,041			500	4,000
1906	2,070	75,555			6,800	115,000
1907	560	21,369			11,600	133,479
1908	590	24,939			11,000	83,000
1909	344	14,226			6,500	29,000
1910	260	11,765				
1911	94	4,325				
1912	646	27,158				
1913	12	483				
1914	13	638				
1915	159	21,793				
1916	1,039	97,146				
1917	2,592	244,810				
1918	2,417	280,333				
1919	1,418	119,142				
1920	[5]					
1921	[5]					
1922	[5]					
1923	528	31,147				
1924	867	60,840				
1925	351	29,134				
Totals	570,791	$3,418,211	1,645	$14,820	41,140	$393,404

---

[1] Includes crushed rock, rubble, rip-rap, paving blocks, sand, gravel.
[2] Eleventh Census Report, Vol. X, Part 3, p. 605.
[3] Estimated.
[4] Flasks of 75 pounds since June, 1904. Previously 76½ pounds.
[5] See under 'Unapportioned.'
[6] There was a considerable production of paving blocks in Sonoma County in the 70's and '80s, but no available records of annual amounts or values.

1873-1925.

Mineral water		Miscellaneous stone[1], value	Magnesite		Miscellaneous and unapportioned		
Gallons	Value		Tons	Value	Amount	Value	Substance
		$					
		$350,000					
		367,500					
		[2]297,236					
		[3]245,000					
		[3]150,000					
		96,000					
		92,800					
		57,381					
8,000	$32,500	69,508					
14,400	19,287	73,719					
236,000	24,000	33,035					
246,680	23,490	43,371					
21,000	18,500	16,830					
575,000	35,000	20,275					
60,900	17,691	52,701	175	$1,225	64 tons	$4,460	Graphite.
30,000	9,100	121,578	130	455	42 tons	1,680	Graphite.
10,000	4,000	90,933					
11,000	4,400	75,947			1,500 bbls.	2,250	Lime.
10,000	4,000	213,830					
10,000	4,000	158,218				300	Gems.
12,000	4,200	132,946	250	1,250	1,500 bbls. 10,500 tons	2,600 50 10,700	Lime. Gems. Clay.
10,000	1,000	307,695	15	180	2,600 tons	3,000	Clay.
104,000	21,350	319,716			500 tons	5,500 15,000	Clay. Unapportioned, 1900-1909.
235,000	50,350	220,998					
202,500	50,250	184,035				1,000	Unapportioned.
62,500	20,950	295,198	300	3,000			
96,240	46,910	191,436					
80,015	46,160	276,516	213	2,130		700	Other minerals.
258,600	41,231	177,917	3,624	34,788		375	Other minerals.
121,366	28,031	232,113	11,653	98,280	243 tons	2,478 14,000	Chromite. Building stone, manganese.
121,290	35,031	146,621	5,636	61,335	226 tons 362 tons	6,200 12,689 64	Chromite. Manganese. Other minerals.
83,220	36,050	148,347	4,110	40,010	1,540 tons 173 tons	73,906 7,645 100	Chromite. Manganese. Other minerals.
96,800	22,820	144,014				62	Building stone, curbing
29,928	6,578	217,667	[6]			63,000	Magnesite, quicksilver.
37,641	9,891	151,300	[6]			14,360	Gems, magnesite, quicksilver.
35,843	9,108	162,679				50,154	Pottery clay, gems, quicksilver.
30,661	7,106	189,059					
31,003	8,002	101,009				2,200	
17,713	6,679	119,546				4,872	Pottery clay, building stone, manganese.
2,899,300	$647,665	$6,344,674	25,236	$242,653		$299,345	

BRICK AND CLAY[1].

There has been in the past a considerable output of brick and clay in Sonoma County, but no clay-working plants are active at the present time, and clay production is almost negligible. Undoubtedly there are many undeveloped clay deposits of potential value. There are samples of clay in the State Mining Bureau museum from Agua Caliente, Guerneville, Healdsburg, Mark West Springs, Santa Rosa, and Sonoma, none of which have been developed. Plants were formerly operated at Glen Ellen, Healdsburg, and Hilton. Most of the material is only suitable for the manufacture of common red brick and tile, but some deposits are of more valuable clays. A small deposit of high-grade pottery clay is reported on the James Henderson Ranch at Glen Ellen. At Skaggs Springs there is a deposit of yellow clay, stated to be suitable for the manufacture of terra cotta.

Weise Clay Pit (also known as Beltane Clay). J. H. Weise, owner, Glen Ellen; Frank Asbury, Los Angeles, lessee. This deposit of white kaolin is in a hill about ¼ mile northeast of Beltane Station, between Glen Ellen and Kenwood. It is a high-grade aluminum silicate. A considerable tonnage has been used in the past by Gladding McBean and Company in the manufacture of fire brick, and by the Santa Cruz Portland Cement Company in the manufacture of a special white cement. Its fusion point is stated to be very high—about 4500° F. The present lessee has shipped a carload or two to Los Angeles for testing in the manufacture of fire brick. There is estimated to be at least 100,000 tons available.

Analysis of 'Beltane clay' by Smith, Emery and Company, Chemists, San Francisco.

	No. 1 (hard)	No. 2 (medium)	No. 3 (soft)
SiO_2	74.60%	56.29%	58.10%
Al_2O_3	15.97%	31.13%	26.79%
TiO_2	.21%	.31%	.56%
Fe_2O_3	.50%	.59%	1.17%
MnO	Trace	------	Trace
CaO	.18%	.05%	.32%
MgO	.06%	.05%	.05%
Loss on ignition	8.80%	11.67%	12.66%
	100.32%	100.09%	99.65%

Bibl: State Mineralogist's Reports VIII, p. 635; XII, p. 384; XIV, pp. 316-318; Bull. 38, p. 258.

CHROMITE.

Deposits of chrome ore occur in a belt of serpentine that strikes northwestward through the western portion of the county. In this same serpentinized area some of the large magnesite deposits occur, notably those in the Red Slide district north of Cazadero. A large tonnage of chromite is reported to have been shipped from the properties of the Asti Colony, three miles southwest of Cloverdale over 30 years ago. This was the only production prior to the period of activity brought on by the World War.

About two thousand tons of chromite were produced in this county during the war period, but most of the deposits consisted of small lenses and kidneys and were soon exhausted. There is no activity at the present time.

---

[1] The State Mining Bureau has in course of preparation a new bulletin on the clay resources of the State by W. F. Dietrich, Ceramic Engineer.

Madeira Deposit. Small lenses in Sec. 31, T. 9 N., R. 10 W. The ore was reported to assay 34% chromic oxide.

Meeker Chrome Mine. During the war period 1400 acres of the Meeker Estate at Camp Meeker were under lease and a number of small and medium size lenses of ore mainly in Sec. 16, T. 7 N., R. 10 W., were mined. This ore assayed 39%-40% Cr_2O_3.

Parmeter Ranch Deposit (Laton Group). This deposit is in Sec. 13, T. 9 N., R. 12 W., eight miles by good road from Cazadero, the nearest railroad point. The deposit as a whole is low-grade, although some high-grade kidneys were taken out. Idle since 1918.

The *Shanks and Copps Lease* was in Sec. 13, T. 10 N., R. 11 W., on the ridge north of Skaggs Springs. A few small lenses of chromite were uncovered.

An unnamed deposit occurs two miles north of the Culver-Baer Quicksilver mine along the same ridge. About 150 tons have been shipped from here.

Bibl: State Mineralogist's Reports IV, p. 137; XIII, p. 50; XIV, p. 319; XVII, p. 248; Bull. 76, pp. 201-203; U. S. Geol. Survey Bull. 430, p. 168.

COAL.

Some small strata of coal are known at several points in Sonoma County, but they are not utilized. Some of these are:

At the head of a gulch ¼ mile from the beach near Fort Ross.

Eight miles east of Stewart's Point on the road to Skaggs Springs.

Pierson Mine, on the Wrightson Ranch, in Sec. 27, T. 8 N., R. 8 W., on the road to Mark West Springs. In 1910 and 1911 some development work was done.

On the *Taylor Ranch*, 2 miles south of Santa Rosa, considerable money was spent in development work about 30 years ago. Though a fair quality of coal was found, the strata were too much broken up.

Bibl: State Mineralogist's Reports VII, Pt. 1, p. 118; VII, pp. 151, 190; VIII, p. 634; X, p. 676; XI, p. 259; XII, p. 61; XIII, p. 55; XIV, p. 319.

COPPER.

Altamont Group. Small masses and specimens of copper ore have been found in Sec. 17, T. 7 N., R. 10 W., two miles south-east of Monte Rio.

Bibl: State Mineralogist's Report XIV, p. 319; Bull. 50, p. 167.

Archer Prospect. In Sec. 30, T. 8 N., R. 10 W., east of Guerneville.

Bibl: Bull. 50, p. 166.

Cornucopia Copper Mining Co. (Squaw Creek, also known as Healdsburg Copper). These claims are in Secs. 33 and 34, T. 12 N., R. 9 W., 14 miles northeast of Cloverdale. They were first located in 1902 and are reached by two miles of trail from the stage road to The Geysers. Assessment work is kept up. W. M. Jacobs, of Healdsburg, is the principal. Cobalt is associated with the deposits here as indicated by samples submitted to the State Mining Bureau laboratory.

Bibl: State Mineralogist's Reports V, p. 97; XIV, pp. 319-320; Bull. 50, pp. 166-167.

DIATOMACEOUS EARTH.

Infusorial and diatomaceous earth (also called diatomite) is one of the important non-metallic mineral products of the State. It is widely distributed and production is on a competitive basis of quality, quantity and price. There are a number of deposits of this material in Sonoma County which are of economic value if they can survive the competitive market.

Goodman Bros. Deposit (Collings Deposit). This deposit, which has been known for years is in Sec. 10, T. 8 N., R. 8 W., one mile north of Mark West Springs and six miles east of Windsor, on the Northwestern Pacific Railroad. Owner, Goodman Bros., Box 213, Route 5, Santa Rosa, Cal.

The diatomaceous shale belt here has been traced for several miles, but it is only on the Goodman Ranch that the pure white diatomaceous earth is found. The bed averages about 12 feet in thickness and has been uncovered for 1500 feet. The material appears to be pure and high-grade. There has been no activity since a small tonnage was shipped in 1913.

Mt. Pisgah Vineyard Deposit. This is on the Goldstein Ranch in Sec. 30, T. 6 N., R. 5 W., two miles northeast of Agua Caliente. Considerable work was done here in 1922 and 1923 by the American Minerals Company in stripping the deposit, which averages 15 feet in thickness, but the company did not get into production. Idle.

Bibl: State Mineralogist's Report XIV, p. 322.

GEM MATERIALS.

Garnets, of two varieties, are found in Sonoma County. Almandite (iron-alumina garnet) occurs in chlorite schist three miles west of Healdsburg, notably on the Cox Ranch. Grossularite (lime-alumina garnet) also occurs in schist near Petaluma, in the vicinity of Gualala, at Camp Meeker and near Healdsburg. Some of the crystals are fully an inch in diameter, but they are not of gem quality. Their most likely commercial utilization would be as an abrasive.

Opals of gem quality and a fair play of 'fire' have been found in association with the clay deposit on the Weise Ranch, between Glen Ellen and Kenwood. A few have been cut and sold. J. H. Weise, Glen Ellen, owner.

C. A. Perry, of Healdsburg, has produced over 100 'Sonoma diamonds' from a deposit a short distance north of Healdsburg, discovered by him in 1917. The stones are in reality rock crystal (quartz) and occur in a hard formation resembling a burnt clay or shale. Only a small proportion of the crystals are prefectly transparent, white and flawless. They are usually cut like a diamond or in what is known as the Twentieth Century diamond cut which contains a larger number of facets.

Bibl: State Mineralogist's Reports IV, pp. 99, 182; VI, part I, p. 91; XIV, p. 320; Bull. 37 p. 52.

GOLD.

Traces of gold have been found at several places in Sonoma County, and a few colors can be obtained in some of the creeks by panning. Nothing of consequence has ever developed.

Bibl: State Mineralogist's Report XIII, p. 436.

GRAPHITE.

There was a small output of graphite from Sonoma County about 25 years ago, but no activity in recent years, although the mineral occurs at several localities.

McPherson Ranch Deposit. There is a deposit of graphite of fair quality on this ranch in Secs. 13 and 14, T. 9. N., R. 10 W., 3½ miles west of Healdsburg. The material is suitable for stove polish, foundry facings, and paint manufacture. By washing and concentrating, a good quality of graphite could probably be produced. Idle.

Skinner Ranch Deposit. This deposit is in Sec. 14, T. 4 N., R. 7 W., four miles south of Petaluma, on the San Rafael road. Several hundred tons have been shipped from here in the past. Idle.

Graphite occurs on Porter Creek in T. 8 N., R. 10 W., in association with a deposit of red ochre (hematite). Undeveloped. It also occurs in the form of graphitic schist, two miles west of Cazadero. W. Porter Barnes, of Cazadero, has submitted samples from that locality. Specimens have also come from the Pine Flat district.

Bibl: State Mineralogist's Reports VI, part I, p. 111; XIV, p. 321; Bull. 38, p. 281.

IRON.

There are indications of iron ore along the second ridge back from the shore line, beginning about six miles east of Fort Ross and continuing northwesterly into Mendocino County. The more important localities are:

Hooper Ranch, J. W. Hooper, owner, five miles north of Nobles.

Lancaster Ranch, W. M. Richardson, Plantation House, owner; east of Fisk's Mill. Both yellow ochre and hematite occur. Some of it is siliceous, and suitable for paint.

Fort Ross, a large body six miles east of Fort Ross.

Bibl: State Mineralogist's Report IV, p. 182; XI, p. 461; Bull. 38, pp. 304, 365.

LIMESTONE AND MARBLE.

Black Ranch Quarry. This deposit is six miles north of Geyserville on Little Sulphur Creek. A little lime was burned here in 1906-1907, but no work has been done since.

Bibl: State Mineralogist's Reports XII, p. 396; XIII, p. 633; XIV, p. 323; Bull. 38, p. 93.

C. A. Perry, Healdsburg, has an option on a deposit of limestone situated about 3½ miles west of Healdsburg. The following analysis was made by Thomas Price and Son in 1906:

	Per cent.
Calcium carbonate	93.45
Magnesium carbonate	1.22
Ferrous carbonate	1.13
Alumina	1.96
Manganese oxide	0.18
Silica	1.59
Organic matter	0.28
Loss and undetermined	0.23
	100.04

They reported the limestone to be well adapted to the manufacture of portland cement.

Shale and clay suitable for use with the above limestone are found in close proximity. The result of an analysis of the shale was as follows:

	Per cent.
Silica	41.52
Alumina	25.07
Ferrous oxide	3.15
Ferric oxide	10.05
Manganese oxide	0.38
Calcium carbonate	7.66
Calcium silicate	3.50
Magnesium oxide	1.12
Alkalies	0.98
Combined water	6.50
Loss and undetermined	0.07
	100.00

The clay showed the following composition:

	Per cent
Silica	55.08
Ferrous oxide	3.15
Ferric oxide	2.19
Manganese oxide	Trace
Alumina	20.14
Calcium oxide	3.86
Magnesium oxide	1.21
Alkalies	1.20
Combined water	12.25
Loss and undetermined	0.92
	100.00

It is stated that cement manufactured from the above raw materials would probably be of a light gray color.

There is a large deposit of limestone in Secs. 1 and 2, T. 9 N., R. 12 W., 15 miles west of north from Cazadero. It is stated to be traceable for a mile in length, and in places up to 300 feet in width. It could be used for building stone or for cement manufacture. It is a hard, fine-grained, compact limestone, red, white, and cream-colored. The deposit was at one time located by the Healdsburg Marble Company but abandoned on account of being too far from a railroad.

MAGNESITE.

There are numerous deposits of magnesite in the county, some of which are in the district around Cloverdale, and another group is situated northwest of Guerneville in a belt of serpentine which strikes northwestward through T. 8 N., R. 10 W., and T. 9 N., R. 11 W. These deposits are described in detail by Bradley[1]. As none of the properties are operating, they were not visited by the writer, and those interested in investigating the magnesite deposits are referred to the bulletin mentioned and other publications listed in the bibliography. The more important deposits are:

Albertz Ranch Deposits. Two miles southwest of Cloverdale. Some production has been made here.

Battenburg Magnesite Mine (also Creon or Kolling Deposit). In Sec. 32, T. 12 N., R. 10 W., three miles east of Preston Station. Several thousand tons have been produced here and the deposit is thought to be pretty well worked out. All equipment at the calcining plant has been removed. The Refractory Magnesite Company is out of existence and the present ownership of the property uncertain.

Burgens Ranch Deposit. One mile north of the Battenburg on the same ridge. Only stockwork and float found so far.

Madeira Deposit (Healdsburg Marble Company). In the southwest corner of Sec. 31, T. 9 N., R. 10 W., 5½ miles north of Guerneville. Patented property. Idle.

Meeker Ranch Deposit. Is in Secs. 2 and 3, T. 8 N., R. 11 E., seven miles by road north of Guerneville. Idle.

Melville Ranch Magnesite (Eckert Ranch; also Yordi Ranch). This deposit is two miles southeast of Cloverdale and was mined spasmodically for a number of years. Idle since 1918 or 1919.

Snyder Ranch Deposit. An undeveloped deposit on the George Snyder Ranch on Piney Creek, about 12 miles northwest of Healdsburg.

Sonoma Magnesite Company (Red Slide Deposits). This group includes some 30 claims on East Austin Creek in Secs. 6, 7, 8, 17, and 20, T. 9 N., R. 11 W., six miles north of Cazadero. A 24-inch gauge railroad eight miles in length, was built in 1914, extending from the narrow gauge line of the Northwestern Pacific Railroad to within three miles of the camp. The deposits were worked for over two years. In 1924 the property was taken over by Spreckels Bros., of San Diego, with a view to using the material in the manufacture of a patent wallboard, but operations soon ceased. It is stated that the magnesite here carries too high a percentage of silica to be suitable for plastic use. Title to the property is now said to rest in the National Magnesite Products Corporation, the mines and equipment having been sold at public auction in 1922 under a judgment held by the latter company.

---

[1] Bradley, Walter W., Magnesite in California, Cal. State Min. Bur. Bull. No. 79, 1925.

Western Carbonic Acid Gas Company. This company's group of claims is at the head of Gillian Creek in Sec. 6, T. 8 N., R. 10 W., seven miles north of Guerneville. A calcining plant was constructed at Guerneville in 1917, but very little ore has been produced.

Bibl: State Mineralogist's Reports XIV, pp. 324-333; XVII, p. 249; Bull. 38, pp. 331-333; Bull. 79, pp. 89-97; U. S. Geol. Survey Bull. 355, pp. 22-28; Bull. 540, pp. 480-498.

MANGANESE.

A few hundred tons of manganese ore were marketed during the World War from deposits in this county, but very few deposits of good grade and workable size have been found to date, the manganese usually occurring only as stains and small pockets in jasper. Most of the occurrences so far developed are described in Bulletin 76, Manganese and Chromium in California, 1918.

Shanks and Copps Lease. This property is located nine miles west of Geyserville, and two miles east of Skaggs Springs. It was in active operation during the World War and produced approximately 1000 tons of ore, reported to average 42% to 50% metallic manganese and 4% to 14% silica. There is stated to be considerable ore still remaining, but the mine has been idle since 1920.

Shaw and Mathews Mine. Is in Sec. 31, T. 12 N., R. 11 W., seven miles northwest of Cloverdale. It was opened up about 40 years ago, but remained idle until 1918, when it was leased and a little work done. The ore appears to be too low grade to be profitably handled.

There is a manganese prospect on the *C. C. Foss* ranch in Sec. 19, T. 11 N., R. 8 E., about one mile above The Geysers. Undeveloped.

Other occurrences have been noted at Pine Flat.

At Skaggs Springs there are extensive outcrops of red jasper stained with manganese and low-grade manganese and iron probably form a large portion of the precipitous mountain on the Skaggs Springs property.

Aho Ranch Deposit. The most recent activity in manganese mining has been on a group of deposits located about seven miles from Cazadero, near the summit on the road from Cazadero to the coast. The principal one is known as the *Drum Manganese Mine.* It has been worked intermittently by various lessees. Good-size lenses, up to six and eight feet in width, have been found. The last shipment of about 80,000 pounds was made by C. P. Seaburg in June, 1926. The manganese is on a ranch recently purchased and now owned by Matt Aho. The owners are continuing development, storing the ore on the dump for future shipment.

J. E. Hayden, of Cazadero, has a deposit in this section also.

Bibl: State Mineralogist's Reports IV, p. 316; XII, p. 330; XIII, p. 507; XIV, p. 333; Bull. 38, p. 337; Bull. 76, pp. 82-83; U. S. Geol. Survey Bull. 427, p. 163.

MINERAL PAINT.

Red and yellow ocher (hematite and limonite) mineral paint pigments were produced here for several years, but none has been mined for a decade or more.

Healdsburg Paint Company Deposits. This property, known and operated in the past under various names, is on Porter Creek in T. 8 N., R. 10 W., ten miles by road southwest of Healdsburg. The material is a low-grade hematite, high in silica.

> Bibl: State Mineralogist's Reports XI, p. 462; XII, p. 406; XIII, p. 643; XIV, p. 333; Bull. 38, p. 340.

Meeker Ocher Deposit. This deposit is an ocherous clay in Sec. 21, T. 7 N., R. 10 W., 1½ miles north of Camp Meeker. Some of this material has been shipped, but none within the last 10 or 15 years.

> Bibl: State Mineralogist's Report XIV, p. 334; Bull. 38, p. 340.

Occidental Deposit. An undeveloped deposit of ocherous clay just west of the hotel at Occidental.

A small deposit of soft red hematite at Mark West Springs has been utilized locally for painting.

Samples of limonite (yellow ocher) have also been received from W. M. Jacobs, Pine Flat; I. Sutherland, Kellogg; and L. Renari, P. O. Box 149, Santa Rosa.

MINERAL WATER.

Sonoma County, like its neighbors, Lake, Napa, and Mendocino counties, has a large number and variety of mineral springs. Some of these are well known, and have a world-wide reputation. They vary in character and composition from the cold seltzer of Lytton's to the boiling hot waters and steam vents of The Geysers. Most of them are well equipped with comfortable hotels and cottages, and are fairly accessible to transportation lines. Sonoma County is one of the 'playgrounds' of California and many of the summer resorts are located around these mineral springs.

Agua Caliente Springs. T. H. Corcoran, Agua Caliente, owner. These springs are at Agua Caliente on the Northwestern Pacific Railroad, 2½ miles northwest of Sonoma; elevation 131 feet (Northwestern Pacific). It is stated that originally the hot spring here was merely a mud hole used for many years by the Indians. The present owner has drilled six wells, and put in a large swimming tank, a bath-house, and a bottling works. The water is pumped, though it is stated that in the winter the wells have a small artesian flow.

The water pumped to the swimming tank shows a temperature of 102° F. at the pump (two wells combined, one of which is said to be warmer than 102°). The well from which water is bottled shows a temperature of 95° F. at the pump, and is discharged into a tank to cool before bottling. Electric power is used, and there is an auxiliary gasoline engine for emergency use. There is a capping machine, carbonator and mechanical labeler. There are accommodations for 300 guests in the hotel and cottages.

> Bibl: State Mineralogist's Reports XI, p. 458; XIII, p. 521; XIV, p. 334; U. S. Geol. Survey Water Sup. Paper 338, p. 113.

Alder Glen Springs. A. Paridi, lessee. These springs are in Sec. 3, T. 11 N., R. 11 W., three miles northwest of Cloverdale; elevation 525 feet (bar.). McCray Station on the Northwestern Pacific is the railroad point. The springs are in serpentinized sandstone, and the four principal ones have the following temperatures: Surphur, 58° F.;

Magnesia, 56°; Soda, 57°; Iron, 57°. The hotel and cottages are picturesquely situated in a beautiful canyon of alders, redwoods and oaks.

> Bibl: State Mineralogist's Report XIV, p. 335; Anderson, Winslow, 'Mineral Springs and Health Resorts of California,' p. 76; U. S. Geol. Survey Water Supply Paper 338, p. 166.

Altamont Springs. A lightly mineralized spring in Sec. 34, T. 7 N., R. 10 W., at Occidental on the Northwestern Pacific Railroad.

Barcal Spring, Barcal Water Company, operators; J. Kolling, Preston, manager. This calcic-magnesic spring is near the Kolling magnesite deposit in Sec. 32, T. 12 N., R. 10 W., about two miles east of Preston on the Northwestern Pacific Railroad at an elevation of 1375 feet (bar.). They have been bottling for about 20 years past, originally at the spring itself, but now the water is piped 9000 feet to the works at Preston Station. Electric power is used and three men are employed. The product is put up both carbonated and natural, and is used in the manufacture of various soft drinks. A new bottling machine has just been installed. There is no resort in connection with this spring. Nearby there is also an iron spring, but not utilized.

Boyes Hot Springs (at one time called Agua Rico). Owned by Sonoma Properties Company. Fred F. Partridge and R. G. Lichtenberg, managers. The post office and railroad station are both named Boyes Springs. It is two miles northwest of Sonoma; elevation 129 feet (Northwestern Pacific).

Water is obtained from both springs and wells. It is pumped to tanks to give pressure for the bathhouse use, and also pumped to the bottling works, where it is cooled before bottling. Electric power is used. The bottling is done under lease from the company. All of the production is carbonated. There is a fine large swimming pool with water at 80° F. and a hot plunge, both in a well-appointed bathhouse. The old hotel burned down in 1923. The Sonoma Properties Company, which has recently taken over the Boyes Springs property, expect to have a new 100-room hotel completed in 1927. A café seating 300, open to the public, and an 18-hole golf course are included in their plans.

> Bibl: State Mineralogist's Reports XI, p. 458; XII, p. 347; XIII, p. 521; XIV, p. 335; U. S. Geol. Survey Water Supply Paper 338, p. 112.

Burns Springs. These springs are on the Hathaway ranch, three and one-half miles east of Glen Ellen. Not utilized except by the owners.

> Bibl: State Mineralogist's Reports XII, p. 347; XIII, p. 521; XIV, p. 336.

Chimney Rock Spring. A sulphur water spring at the corner of Secs. 26, 27, 34, 25, T. 8 N., R. 11 W., six miles west of Guerneville, close to Chimney Rock, a natural topographic feature.

> Bibl: State Mineralogist's Report XIV, p. 336.

Fetters Hot Springs. George Fetters, owner. This resort at the post office of the same name is between Boyes and Agua Caliente springs in the warm water belt extending northwesterly from Sonoma. Elevation 124 feet. There are three wells, stated to be artesian in winter, the first one of which was drilled in 1908. The warm water was struck at a depth of 300 feet. It is pumped, using electric power, to a tank for swimming and the bathhouse. The temperature of the two principal wells are given as 114° F. and 90° F.

Bibl: State Mineralogist's Report XIV, p. 336; U. S. Geol. Survey Water Supply Paper 338, p. 114.

Hoods Hot Springs. Comprises two springs of small flow in the canyon of Dry Creek, 15 miles northwest of Cloverdale. Only used locally. Temperature 100° F.

Bibl: State Mineralogist's Report XIV, p. 336; U. S. Geol. Survey Water Supply Paper 338, p. 82.

Iron Spring. M. Gross, owner. Situated opposite Agua Caliente and Fetters. There is one cold spring said to be mineralized with iron and sulphur. Used for drinking only. There are hotel accommodations for 50 people.

Kawana Springs (formerly *Taylor's White Sulphur Springs*). These springs are in Sec. 36, T. 7 N., R. 8 W., 2½ miles southeast from Santa Rosa; elevation 276 feet (bar.). The principal spring has a temperature of 57° F.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 75; X, p. 676: XIV, p. 337; U. S. Geol. Survey Bull. 32, p. 209; Water Supply Paper 338, p, 256; Anderson (op. cit.).

Kenwood Springs. Audrey Elston, owner, Kenwood. These springs, which are cold and said to contain magnesia and iron, are located 1½ miles northeast of Kenwood on Sonoma Creek. The water is used for drinking. A swimming tank is supplied from the creek. There is a small hotel, cottages and camp ground, which will accommodate about 100 persons.

Mark West Springs. Bertha Munger Seberg, owner. These well known springs are in Sec. 14, T. 8 N., R. 8 W., 10 miles north of Santa Rosa, from which city they are reached by automobile stage; elevation 450 feet (bar.). The warm springs are on the edge of Mark West Creek. The following temperatures have been observed: Bath Spring, 93° F. (strong flow); Magnesia, 90°; 'Plunge,' 92° (has excess gas); Sulphur, 90°; Arsenic, 65°; two, iron 58° each; one, iron 54°; two 'iron' across creek from others, 67°. The Bath Spring water, when a higher temperature is desired, is heated artificially.

The hotel, which has been recently modernized, cottages, and tents will accommodate about 150 guests. One picturesque feature of this resort is the large wild grape arbor in front of the hotel. There are eleven trunks up to 8 inches in diameter, which are twined around the porch posts, and the vines spread out on the arbor frame over the driveway.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 75; VIII, p. 634; XII, p. 347; XIII, p. 522; XIV, p. 337; U. S. Geol. Survey Bull. 32, p. 206; Water Supply Paper 338, p. 115; Anderson (op. cit.).

On the *James O'Brien Ranch*, one mile northwest of Sea View, in Sec. 7 T. 8 N., R. 12 W., there is a cold mineral water well. It is at the station on the stage road west from Cazadero.

O'Donnell's Sulphur Spring is near Glen Ellen.

Ohms Springs—a drilled well one-half mile southeast of Boyes Springs. A small resort.

Bibl: U. S. Geol. Survey Water Supply Paper 338, p. 113.

Salvation Army's Boys and Girls Industrial Home and Farm (inc.) (formerly Lytton Springs; also Golden Gate Orphanage); post office, Lytton. These springs were originally and for many years known as Lytton Springs. The property is now maintained as an orphans' home by the Salvation Army. There are two principal springs, with the following temperatures: Soda, 64° F.; Seltzer, 62°. The soda spring is at an elevation of 425 feet (bar.), or 200 feet higher than the 'seltzer' and one-half mile distant. Water is free to the public. It is no longer bottled.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 74; VIII, p. 634; X, p. 675; XII, p. 347; XIII, p. 522; XIV, p. 338; U. S. Geol. Survey Bull. 32, pp. 205-206, 211; Water Supply Paper 338, p. 165; Anderson (op. cit.).

Skaggs Hot Springs. Peter J. Curtis, owner, Skaggs. This group of well known hot springs is on Warm Spring Creek in Secs. 23 and 24, T. 10 N., R. 11 W., nine miles west of Geyserville. It is easily reached by good road from the State highway. The springs have been used as a resort since 1857. The present owner bought the property in 1913.

There are three principal springs with good strong flows, and all have an excess of carbonic acid gas and are notably free from sulphuretted hydrogen. The following temperatures have been recorded: 124°, 125° and 130° F. There is an exposure here of the older sedimentary (possibly cretaceous) rocks, including sandstone and shale from which the springs issue. Waring[1] states "The water at Skaggs is not perceptibly sulphuretted, but it has a distinct oily odor and taste." The above quotation is of interest, as a well put down for water in 1922 developed considerable quantities of inflammable gas and traces of oil of high gravity and paraffine base. Gas was also found issuing from the ground in the hillside back of the hotel and a short tunnel developed a supply which was ignited and burned for several months. A chemical analysis showed:

	Per cent
Carbon dioxide	6.7
Illuminants	.4
Oxygen	5.3
Hydrogen	nil
Carbon monoxide	nil
Methane	33.9
Ethane	2.9
Nitrogen	50.8

Its heating value was calculated to be 423 B.t.u. per cubic foot.

These developments led to the drilling of a well by the *Skaggs Springs Oil and Gas Company*, and a hole was put down to a depth of 400 feet. Considerable gas was developed and a strong flow of pure water. Drilling has not been carried farther up to the present time, although the formations are considered favorable for the production of high gravity oil in small quantity from a comparatively shallow depth. During the preliminary investigations it was found that some of the sandstone strata are heavily impregnated with arsenic in the form of realgar. While not considered an extensive deposit at first, this formation has recently been traced across the creek and the arsenic-bearing sandstone shown to extend at least ¼ mile in length. Associated with the realgar in the same sandstone stratum is what apparently is a new mineral heretofore unknown and tentatively named Curtisite in honor of the discoverer, Peter Leo Curtis. The mineral is found in the form of a greenish yellow coating and filling of seams in the rock. It is a natural hydrocarbon compound, the exact nature and composition of which has not been fully determined. Research work on it is being done in the laboratory of the U. S. Geological Survey.

---

[1] Waring, Gerald A., Springs of California, U. S. Geol. Survey Water Supply Paper 338, p. 81, 1915.

A large swimming tank is supplied by the combined overflow of all the mineral springs. The hotel, cottages and tents will accommodate 250 guests.

The Geysers. Owner, Geysers Development Co.; J. D. Grant, president, Healdsburg, California; R. B. Kidd, manager, The Geysers. Prior to 1921, 'The Geysers' of Sonoma County, formerly owned for many years by D. and H. A. Powell, of San Francisco, meant simply another mineral spring resort, but one famous for its scenic features, boiling hot springs, fumeroles, and steam vents. The locality is said to have been first brought to public notice in 1847, and it has been of more or less scientific interest ever since, although there are no true geysers (spouting high into the air), as the name infers. It has been a resort for more than a half-century, and has been visited by many internationally known personages, including General Grant, Mark Twain, Horace Greeley, J. P. Morgan, and Edward the VII, of England.

These springs are situated in the northern corner of Sonoma County in Sec. 13, T. 11 N., R. 9 W., 18 miles east of Cloverdale; elevation 1450 feet at the hotel. The geysers themselves are a series of boiling hot springs in two short tributary canyons on the north side of the rugged canyon of Big Sulphur Creek, one time called the Pluton River. The Little Geysers, an area of similar character but much less extent, is situated about 3 miles above here, on the same creek.

The ebullition in many of the springs is so violent that the water is projected a short distance. Deposits of sulphur, iron sulphide, epsomite, and other salts and minerals are continually forming around the vents, the result of deposition from the vapors and disintegration of the rocks. Below, on the edge of the main creek, there are other mineral springs known as 'White Sulphur,' 68° F.; 'Hot Sulphur,' 100°; Hot Iron, 130°, and Hot Magnesia, 143°. Water and steam from the springs is piped across the ravine and supplies the bathhouse and vapor baths. Steamboat geyser is a steam vent a little east of the main group in another ravine. It has a temperature of 212°.

The mineral waters here form a remarkable series, containing sulphates, carbonates, silicates, and borates of potassium, sodium, magnesium, calcium, iron, and aluminum. Gases from the steam vents (and wells drilled in the fumarole area) have been shown to be radioactive[1].

---

[1] Bradley, Walter W., Radioactivity in Thermal Gases at The Geysers, Sonoma County, California. State Mineralogist's Report XVIII, pp. 545-550, 1922.

The rocks in this area consist of broken and much altered sandstone and shale with cherts, schist and associated bodies of serpentine.

Because of the adjacent quicksilver districts, these hot springs have been much described and discussed in relation to the association of hot springs with the genesis of quicksilver ores.

Since 1920, when John D. Grant, of Healdsburg, took a lease and option on the Geysers property, it has become the center of interest of a new steam power development project. Besides making improvements at the bathhouse and hotel, Mr. Grant conceived the idea of developing steam for the generation of power and began drilling a well in the summer of 1921. This well was not completed, as the casing collapsed. A second well called No. 1 was put down with 12-inch casing to 105′ then an 8-inch casing inside of that down to 118′, after which the hole was drilled in rock without casing to its final depth of 204′. At this depth a crevice was broken into (27 such crevices were passed in drilling between 124′ depth and the bottom), and the pressure developed was so great that drilling was suspended. It was the gases from this well that were tested for radioactivity by Bradley[1] in 1922. At that time, with the top valve closed and the valve in the 8-inch horizontal pipe wide open, the steam gauge at the well showed 60 pounds pressure. With both valves closed the gauge registered 70 pounds. A Brown expansion pyrometer indicated a temperature of 530° F. within the chamber of the top gate-valve while discharging wide open.

Close up view of No. 1 and No. 2 steam wells, the first two drilled. The Geysers, Sonoma County.

The encouraging results led to the organization of the Geysers Development Company, which now owns several thousands acres, including 'The Geysers' proper, located about the center of the 'heat belt,' the Little Geysers, at the eastern end of the belt, and practically all of the adjoining area showing thermal activity. This heat belt extends for six miles along the main canyon and steam is in visible evidence at five distinct localities.

---

[1] Bradley, Walter W. (op. cit.).

Development of Natural Steam Wells for Power Purposes at 'The Geysers.'

The work carried on by the Geysers Development Company for this most unusual project (the only one known outside of that at Larderello, Italy) is described in a paper by Mr. J. D. Galloway[2], consulting engineer for the Company. Mr. Galloway kindly permitted the writer full use of his manuscript in preparing the following notes:

Geology.

A geologic reconnaissance was made by Mr. L. C. Decius, geologist. Mr. Decius conceives the canyon of Sulphur Creek to be a major fault extending for many miles southeastward, and the reason for the existence of the fumeroles and hot springs at The Geysers to be a weakened fractured zone or fault through which both magmatic and meteoric waters find their way to the surface; the magmatic waters from the earth's centrosphere and the meteoric waters from a maximum depth of 6½ miles to which they may possibly percolate downward. His conclusion is that the fumeroles have their origin in the molten mass of the earth's magma, the heat being transmitted to the surface by steam and other vapors escaping through the fractured fault zone, and that there is no reason to expect the cessation of the escape of the magmatic vapors.

The Wells.

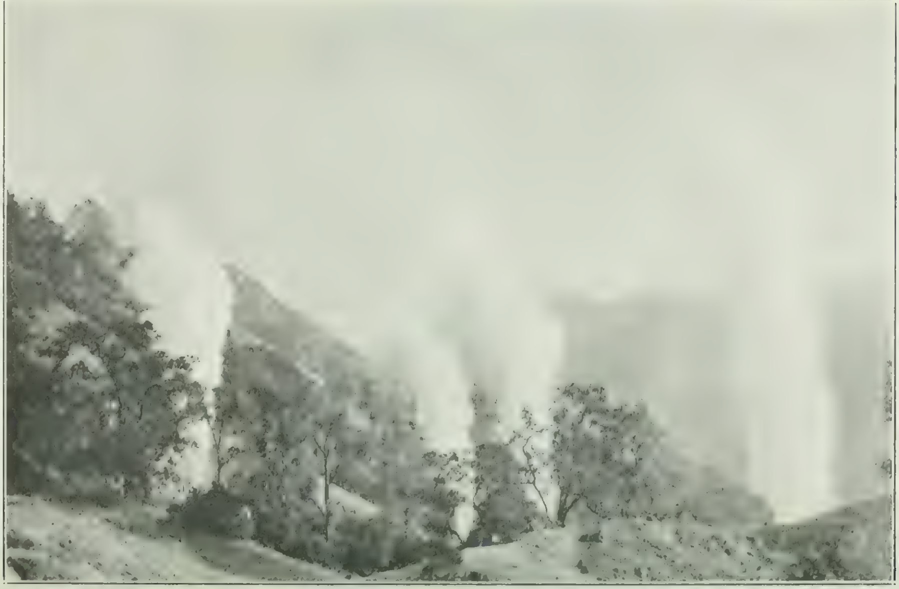
Well No. 1 was commenced in 1922 and completed to its final depth of 204 feet in September of that year. Well No. 2 was started October 17, 1922, and completed to a depth of 320 feet on July 20, 1923. Well No. 3 was begun in the summer of 1924 and was down 150 feet when work was stopped. Wells No. 1 and No. 2 are cased with 8-inch casing. The first three wells were drilled with a light Keystone churn-drill rig. The steam coming into the wells during drilling was controlled by a stream of cold water poured into the well. This water was blown out of the wells at intervals of half an hour or so by the geyser action of the steam.

In May, 1924, Mr. Galloway made tests of the amount of steam coming from wells No. 1 and No. 2 by steam flow meters. The static pressure on these two wells was then 62 pounds per square inch. Their flow warranted the drilling of more wells to prove the extent of the steam area, and arrangements were made by the company with the Diamond Drill Contracting Company to drill more test wells. A rotary drill rig with special arrangement for control of the steam pressure by circulating water was installed and during the first seven months of 1925 five wells of the later series of tests, No. 4, No. 5, No. 6, No. 7 and No. 8 were drilled.

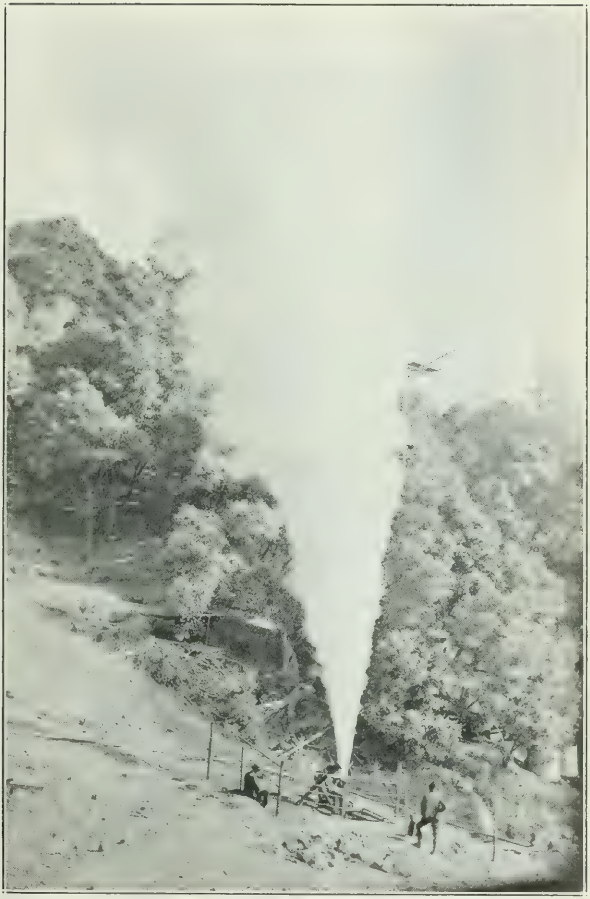
The first four wells in this series are of the same size and type and are distributed over an area about 550 feet long. An open hole is first drilled through the overburden and into rock as far as possible. Into this hole a ten-inch wrought-steel casing is set and the space between casing and the walls of the hole filled with portland cement grout. After the cement is set, the hole is drilled deeper into the rock until the flow of steam is good and then an inside eight-inch wrought-

---

[2] Civil Engineer, First National Bank Bldg., San Francisco.



Four steam wells discharging. From left to right, No. 7, No. 6, No. 5 and No. 4. Taken October 16, 1925. The Geysers, Sonoma County. Photo by courtesy of J. D. Galloway.



Steam well No. 5 discharging. The Geysers, Sonoma County.
Photo by courtesy of J. D. Galloway.

Distant view of steam wells at The Geysers, looking across Big Sulphur Creek Cañon from the Hotel. Taken in August and with wells discharging into the ground to muffle the roar of escaping steam.

steel casing inserted and the space between the two casings is filled with cement grout which is allowed to set. After this the well is drilled as an open hole deeper into the ground. The following is a tabulated statement of the conditions of wells No. 4, No. 5, No. 6, and No. 7, with some figures for No. 8 now drilling:

TABLE NO. 1.

	No. 4	No. 5	No. 6	No. 7	No. 8	
Depth of 10" casing	153'	91'	83'	103'	68'	(15")
Depth of 8" casing	256'	203'	208'	176'	160'	(12")
Depth to bottom of well	451'	416'	487'	483'	---	

The successful results of these wells led to plans for drilling larger wells, and it will be noted that well No. 8 has a 15" outside casing and a 12" inside casing. This latter well is not yet completed.

In drilling the wells, the incoming steam is condensed by a stream of cold water pumped down to the bottom of the well through the interior hole of the drill stem. The water is sent down under pressures up to 250 lbs. per square inch and under the pressure rises to the top of the well outside the drill stem and flows off through a side vent. A point is reached when the cold water sent down comes back heated to near the boiling point and this indicates about the depth required. All openings on the well are then closed and the drill removed. When all is clear, a valve at the top is opened and the hot water is blown from the well by the geyser action. Rocks and dust are also blown out and it takes a week or so before the discharge clears the passages.

The hardness of the rock varies greatly. The drill often encounters fissures or fumaroles in its passage downward and these underground fumaroles indicate the presence of steam.

The wells are very spectacular, especially in cold weather when the steam can be seen rising to a height of 500 feet or more. The steam escapes with a deafening roar from the wells when blowing off and for this reason must be diverted into the ground in order to muffle the sound, so that the drillers may work.

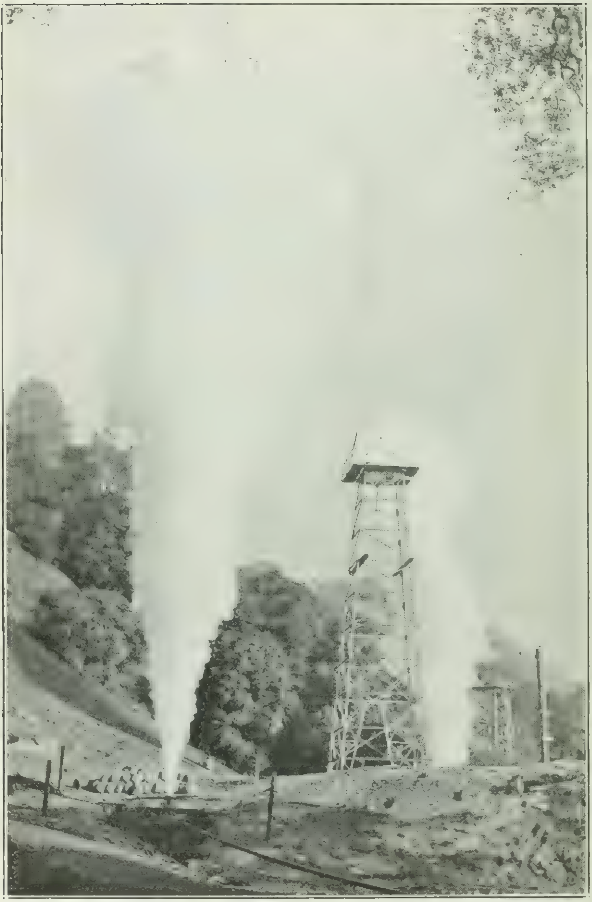
Characteristics.

The steam pressure, wells closed, varies, and the same is true of the quantity of steam discharged under different pressures. In the case of wells No. 6 and No. 7, the wells have not been closed long enough to indicate the maximum pressure, but it is believed that it will reach 300 pounds to the square inch. After well No. 6 was brought in with an initial closed pressure of about 250 pounds, the static pressure in other wells has become greater. The following table indicates this:

TABLE NO. 2.

	No. 1 lb.	No. 2 lb.	No. 4 lb.	No. 5 lb.	No. 6 lb.	No. 7 lb.
Initial static pressure	64	67	82	143	240	198
Static pressure, September	67.5	67.5	107	211	276	---

The data for No. 7 are not complete, as there was no provision for allowing the large valves to be operated under the anticipated pressures.



Steam Well No. 6 in foreground discharging. Derrick over Well No. 9 in center. Well No. 5 in background discharging. Derrick over Well No. 8 in background. The Geysers, Sonoma County. Photo by courtesy of J. D. Galloway.

Tests.

Numerous tests of the quantity of steam flowing from the wells have been made. Steel discs $\frac{1}{16}''$ thick with circular openings of different diameters are clamped between flanges and the steam allowed to escape until such time as the pressure becomes constant for each disc. The edge of the opening in the disc is rounded to a knife edge from which the diameter is measured. Pressures are read by calibrated test gauges on a pipe tapped into the well casing a few feet below the orifice and the quantity of steam flowing determined by Napier's formula. The tests for quantity of steam made with disc openings of different diameters with resulting different pressures give a series of data for each well that may be platted as a curve.

In making the tests for quantity of steam, it was endeavored to have the measurements taken after the well had been discharging for some time under pressures and conditions that would approximate those of an operating steam plant. There is a cumulative effect when the wells are closed for a period and the steam seems to fill crevices in the earth. When opened, if readings are taken immediately, a greater quantity of steam is indicated than when the well has blown off for a period. The data on well No. 4, seems to be a case in point, but the similar change in well No. 5 is not of the same order. Since No. 5 was opened there has been a steady increase in pressures and in quantity of steam produced.

A considerable difference in quantity and pressure of steam is found in the different wells. No. 1 and No. 2, which are some distance from the others and not so deep, stand at 62 pounds gauge pressure when closed. These wells are close together and undoubtedly connected. Wells No. 4, No. 5, No. 6 and No. 7, driven under supervision of Mr. Galloway in 1925, show wide differences. No. 4, No. 6 and No. 5 lie in a straight line in the order named, the distance between No. 4 and No. 6 being 275 feet and between No. 5 and No. 6 the same; No. 6 being midway between No. 4 and No. 5. The maximum static pressure for No. 4 is 111 pounds; of No. 6, 276 pounds, and of No. 5, 210 pounds. It is probable that if No. 4 were drilled deeper it would deliver greater quantities of steam and register greater pressures. Well No. 7, 160 feet distant from No. 6 at right angles to the line of the other wells, is somewhat larger than No. 6 and it is thought the static pressure of this well will reach 300 pounds. The highest yet reached is 276 pounds in No. 6. After the wells have been open for a time, and are then closed, the pressure rises rapidly. No. 6, opened for several weeks and discharging at about 150 pounds, rose to 270 pounds pressure in fifty minutes. However, after a well has been open, it takes several days to build up to the highest pressure recorded.

In practice, since the wells must deliver steam into a common header, the quantity of steam from each well will vary. If seventy-five pounds header pressure be assumed, then the four wells described will deliver the following quantities of steam per hour:

Well No. 4	7,500 lb.
Well No. 5	52,000 lb.
Well No. 6	38,000 lb.
Well No. 7	40,000 lb.
Total	137,500 lb.

With a water rate of 27.5 lb. per kilowatt-hour, condensing, these four wells represent a switchboard delivery of 4500 kw., after allowing 10% losses in steam in transmission. Each well on the average will thus deliver about 1000 kilowatts.

It will be noted that all the pressures given are gauge pressures.

The question might be asked why the wells are not drilled deeper, as the higher pressures and larger quantities are found at the lower limits of the wells. It can be answered that pressures up to 250 pounds and 300 pounds are high pressures. However, the principal reason for not going deeper is found in the nature of the ground through which the wells are drilled. It is naturally porous as shown by the surface vents. As the wells are only cased to a depth of about 200 feet, the higher pressure steam from the lower depths is brought in contact with existing fumaroles of the upper rocks, and it might tend to open up an escape through some fissure in the upper rocks. Again, the seal of the casing against the rock is not absolute, and there is danger of blowing out alongside of the casing or of blowing out the entire casing; such accidents having occurred in oil wells subject to high gas pressure. For these reasons it is believed that 300 pounds gauge pressure is as high as should be developed.

Gases.

From the experience gained at the steam wells at Larderello, Italy, it was anticipated that gases other than steam would be found mingled with the steam. There are numerous gases in the surface strata, but the steam from the wells shows a smaller percentage of gases than at Larderello. Tests of gases from Wells No. 1, No. 2, No. 3, and No. 4 have been made and the results are given in the following table:

TABLE NO. 3.

Analysis of Steam.

(Per cent by volume.)

	Well No. 1	Well No. 2	Well No. 4	Well No. 5
Noncondensible gas—	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1st test	1.47	1.13	0.82	0.70
2d test	1.43	1.16	0.81	0.69
Average	1.45	1.14	0.82	0.70

Analysis of Noncondensible Gas.

(Per cent by volume.)

	Per cent	*Per cent*	*Per cent*	*Per cent*
Ammonia (NH_3)	Trace	Trace	Trace	Trace
Hydrogen sulphide (H_2S)	2.60	2.70	2.80	2.80
Carbon dioxide (CO_2)	66.60	67.30	67.20	68.20
Unsaturated hydrocarbons	Nil	Nil	Nil	Nil
Oxygen (O_2)	0.20	0.30	0.30	0.20
Hydrogen (H_2)	13.80	13.1	12.60	12.20
Carbon monoxide (CO)	Nil	Nil	Nil	Nil
Methane (CH_4)	11.80	11.10	11.70	12.10
Ethane (C_2H_6)	0.50	1.10	0.60	0.70
Nitrogen (N_2)*	4.50	4.40	4.80	3.80
	100.00	100.00	100.00	100.00

* Including inert soluble gases, if present.

Analysis of Condensed Water.

(Volumes of gas per 100 volumes of water.)

Ammonia (NH_3)	11.8	13.4	17.9	16.8
Hydrogen sulphide (H_2S)	3.4	3.4	4.7	4.2
Carbon dioxide (CO_2)	14.9	15.0	15.2	15.1
Total dissolved gases	30.1	31.8	37.8	36.1

Analysis of Steam.

(Per cent by volume.)

	Per cent	*Per cent*	*Per cent*	*Per cent*
Noncondensible gases	1.45	1.14	0.81	0.70
Soluble gases	0.02	0.03	0.03	0.03
Steam (by difference)	98.53	98.83	99.16	99.27
	100.00	100.00	100.00	100.00

A question also arises as to the effect of these non-condensible gases in a condenser or to their effect upon a turbine if they are not removed. At Larderello, the plan at first adopted was to regenerate pure steam, using the natural steam in boilers, but the deterioration of the regenerative boilers was rapid. Later a degasifier was adopted which seems to have been more successful. At The Geysers some tests have been made on turbine blades of different metals and a small turbo-generator set containing blades of different metals has been operated on natural steam from Well No. 6. The engines of the drilling rig have used the steam for nine months with no trace of corrosion. So far the tests indicate that a metal for turbine blades can be made which the gases will not attack. It is to be noted in this connection that copper or alloys containing copper are quickly eaten away by the gases.

The problem of developing a steam plant at The Geysers has been considered and estimates prepared for condensing and non-condensing plants. If a condensing plant is used, cooling towers are necessary, as the flow of the stream in summer is not sufficient for the condensers. There seems to be no doubt that the problem presented by the non-condensible gases can be solved. The development of steam at high pressures from the ground by wells is an unqualified success, and the extent of the territory gives promise of a large development.

Bibl: State Mineralogist's Reports IV, p. 182; VI, Pt. I, p. 75; VIII, p. 635; X, pp. 672-675; XII, p. 347; XIII, p. 521; XIV, pp. 338-341; U. S. Geol. Survey Mon. XIII, p. 377; Bull. 32, pp. 204, 206; Water Supply Paper, 338, pp. 83-88; Anderson, Winslow (op. cit.); Geol. Survey of Cal. Geology, Vol. 1. Galloway, J. D., Paper.

Wall Spring. This is a magnesia spring in Sec. 30, T. 8 N., R. 9 W., northeast of Hilton.

Bibl: State Mineralogist's Report XIV, p. 341; U. S. Geol. Survey Water Supply Paper 338, p. 257.

In addition to the above, there are a number of small locally known warm and cold sulphur and magnesium springs of no economic importance at various localities in the county.

Bibl: State Mineralogist's Report XIV, p. 341; U. S. Geol. Survey Water Supply Paper 338, pp. 114, 258.

NATURAL GAS.

At several places in the vicinity of Geyserville, in the valleys of Sonoma and Petaluma creeks. at Skaggs Springs, and in the Petaluma district, where drilling for oil is now going on, more or less natural gas has been encountered in well-boring operations. There is no commercial production, although there is probably enough going to waste at Witt and Associates oil well in the Petaluma district to supply gas for drilling operations at one of the other wells, if a pipe line was put in. (See Petroleum.)

PETROLEUM.

The possibilities of oil production in Sonoma County are discussed by Vander Leck[1] in Bulletin 89, pp. 36-38. The evidences as to petroleum are stated as follows:

> "On the Ducker ranch, three and one-half miles east of Petaluma and one and one-half miles east of the old adobe fort, in the bottom of a small canyon, there are seepages of a heavy black asphaltic oil in the blue sands of the San Pablo formation. These beds are apparently dipping at an angle of about 40° to the southeast. About 1909 four wells were drilled on the mesa just above the seepages. The Ramona Oil Company drilled three of the wells and the Petaluma Home Oil Company, one well. These holes have now been abandoned. Well No. 1 of the Ramona Oil Company was drilled in blue clay and brown sand to a depth of 800 feet, where it is claimed that gas was struck, which had a pressure of 217 pounds and a flow of 690,000 cubic feet per 24 hours. The well, however, soon clogged up and the flow ceased.
>
> "Well No. 2 was drilled to a depth of 910 feet, logging oil sands at 335 to 400 feet. In none of these wells, however, was oil obtained in commercial quantities."

Undismayed by the failure of these wells to produce, renewed efforts have been made during the past few years, and a small production of oil is now being obtained in the Petaluma district. From January, 1922, to July 31, 1926, the following notices of intention to drill in Sonoma County, were filed with the Department of Petroleum and Gas of the State Mining Bureau:

Year.	*Company.*	*Location Sec. T. R.*	*Well No.*
1922	Sage and Olson	Miller Ranch	1
1922	Sage and Olson	Shoults Ranch	1
1923	Beach and Landini	4- 9- 9	1
1923	Edgar T. Wallace	Ducker Ranch --- 5- 6	1
1923	Alexander Valley Oil Co.	--10- 9	1
1923	Skaggs Springs Oil & Gas Co., Inc.	24-10-11	1
1923	Skaggs Springs Oil & Gas Co., Inc.	24-10-11	2
1924	Alexander Valley Oil Co.	8- 9- 8	2
1924	Herbert N. Witt	--- 5- 6	2
1926	O. F. W. Drilling Co., Inc.	--- 5- 6	1
1926	Shell Co.	Lot 27 Rancho Petaluma, Murphy	1

The last three are the only ones now active.

The Herbert N. Witt notice was filed in August, 1924, and in the latter part of 1925 H. N. Witt and associates completed and brought in their well on the Ducker Ranch with an initial flow of 19° Be. gravity oil at the rate of about 20 barrels per day. This output declined rapidly, however, to about one-half the initial flow. The well

---

[1] Vander Leck, Lawrence. Petroleum Resources of California, Cal. State Mining Bur. Bull. 89, 1921.

---

[3] Whitney, J. D., Geol. Surv. of Cal., Geology, Vol. I, p. 89, 1865.
[4] Raymond, R. W., Min. Res. West of the Rocky Mts., 1874, p. 30.

FOLD OUT

---

[3] Whitney, J. D., Geol. Surv. of Cal., Geology, Vol. I, p. 89, 1865.
[4] Raymond, R. W., Min. Res. West of the Rocky Mts., 1874, p. 30.

is now on the pump and five to seven barrels per day are being recovered. The so-called Witt sand from which this oil is obtained was struck at a depth of 967 feet. This showing, which is one of the best so far developed in the northern counties, created considerable interest, and leasing of the surrounding territory and drilling by other operators soon began. At the present time the O. F. W. Drilling Co., Inc., is putting down a well, and the Shell Company is also drilling a test well, which will probably be a deep test to determine if there are other more productive sands below the Witt sand. The accompanying map[1] of the district shows the various leases and the location of wells now producing or drilling. The showing so far is encouraging, but the extent and productivity of the area is still undetermined. Aside from the three operators named no activity is going on at this time at the other locations for which permits to drill have been issued.

QUICKSILVER.

There is little that can be added to the detailed report on the quicksilver mines and resources of Sonoma County, contained in Bulletin No. 78 of the State Mining Bureau by Bradley[2], published in 1918.

Bradley describes the geology and ore occurrences in various parts of the county, lists all the mines, records their development and possibilities, and describes their metallurgical practice. His report also contains a geological map of the quicksilver district and a bibliography of publications referring to each individual mine and to the general subject in all its phases.

Quoting from the introductory chapter on Sonoma County's mines, Bradley says:

> "The Sonoma County quicksilver deposits, particularly those of the Pine Flat district, are among the oldest known in the state. They vary in character from the ordinary, mainly cinnabar-bearing ores, and the less common meta-cinnabarite, to the purely native mercury type as in the Rattlesnake and the Socrates. This last named group is found in the Pine Flat district, southeast of The Geysers; and has proved so far the most difficult to handle both from a mining and a metallurgical standpoint.
>
> "Prospecting and exploitation of the Pine Flat belt of deposits began in the early sixties and in 1861 some 33,000 feet of claims had been located on it[3]. Among the claims being worked in that year were the Cincinnati, Dead Broke, Pittsburg, Pioneer (later renamed Socrates), and Denver. Though small amounts of quicksilver were produced by a retort from the Pioneer's native mercury ore, the result was not profitable from a pecuniary standpoint. The first definitely recorded output of quicksilver in the county was from the Sonoma mine in the same district in 1873[4].
>
> "With the exception of the Great Eastern lode which is isolated from the other quicksilver deposits of this section of the state, the quicksilver mines of Sonoma County are located at the western end of what is known as the Mayacmas District, the general geology of which is described in a preceding section of the present report. The Cloverdale is the westernmost mine on this belt. The ore-bearing zone, which strikes southeast in the Cloverdale turns abruptly to the south at the Squaw and Buckeye claims, crossing to the opposite side of Big Sulphur Creek; then turning again runs south of east through the Esperanza mine, passing to the south of The Geysers, and continuing southeasterly through the Socrates mine in the Pine Flat section. In the Cloverdale, the dip is northeast at about 70°, east at the Buckeye, and southwest at the Socrates. While native mercury is a character-

---

[1] Map supplied through the courtesy of Sonoma County Land Title Co., Santa Rosa. Lease data furnished by Mr. J. I. Jewell, Santa Rosa.

[2] Bradley, Walter W., Quicksilver Resources of California, State Mining Bureau Bull. 78, 1918.

[3] Whitney, J. D., Geol. Surv. of Cal., Geology, Vol. I, p. 89, 1865.

[4] Raymond, R. W., Min. Res. West of the Rocky Mts., 1874, p. 30.

istic in the southeastern part of this zone, none is found in it north of Big Sulphur Creek.

"As will be noted from the table of production, there have been two principal periods of activity in the yield of quicksilver from Sonoma County mines previous to the present one, 1874 to 1883 and 1888 to 1906. From 1882 to 1894, the Great Eastern mine was the only producer."

The total recorded production of the county has been close to 75,000 flasks, valued at approximately $3,500,000.

Bulletin No. 78 is still available and no attempt will be made at this time to give a comprehensive report on the quicksilver industry, partly because it is now dormant, and also because it would be a needless repetition of existing data. So far as the writer could learn, there is not at the present time a single producing property in the county. The most recent output came from the Cloverdale mine, but this mine shut down in September, 1925. There have been rumors of the re-opening of some of the properties, but so far no actual work has been started. A few of the more important properties will be briefly mentioned.

Buckeye Mine. Owner, C. A. Baumeister, Cloverdale. Located in Secs. 3 and 4, T. 11 N., R. 9 W.; adjoins the Cloverdale Mine.

Cloverdale Mine. Last operated by Balch and Gould. Idle since September, 1925. Subsequent to the publication of Bulletin No. 78, the Western Mercury Company, former owners, installed a rotary reduction furnace. A description of the equipment installed and its operation is given in State Mineralogist's Report XVII, pp. 250-252.

Culver-Baer Mine. Owned by the Culver-Baer Mining Company, C. E. Humbert, president, Cloverdale. A former good producer. Has been idle since 1919.

Great Eastern Mine. Owned by Great Eastern Quicksilver Mining Company, George Roeth, president, 450 Mountain Avenue, Oakland. This mine is credited with the production of the greater portion of the output of the entire county. The mine is in Sec. 16, T. 8 N., R. 10 W., four miles northeast of Guerneville. It has not been worked since 1919.

New Sonoma Mine. Property consists of a group of claims in the Pine Flat district in Secs. 4 and 5, T. 10 N., R. 8 W. Owned by the New Sonoma Quicksilver Mining Co., Inc. There has been some litigation over title to the claims. Idle.

Rattlesnake Mine. In Sec. 31, T. 11 N., R. 8 W. Native metal occurs in the ore at this property. Idle.

Socrates Mine. At the corner of Secs. 32 and 33, T. 11 N., and Secs. 4 and 5, T. 10 N., R. 8 W., in the Pine Flat district. The mine is equipped with a Scott furnace and has made considerable production. Much native metal occurred here, especially in the upper levels. Shut down in 1919.

Bibl: State Mineralogist's Reports I, p. 26; IV, pp. 338-344; VI, Pt. II, pp. 72-73; VIII, pp. 632-633; X, p. 675; XI, pp. 460-461; XII, p. 371; XIII, pp. 602-603; XIV, pp. 316, 342-351; XVII, pp. 250-252; Bull. 27; Bull. 78; U. S. Geol. Survey Mon. XIII; Mineral Resources, various years. For an extended bibliography, see Bulletin No. 78.

STONE INDUSTRY.

(Crushed rock, sand and gravel.)

These materials, and in former years paving blocks, designated in the trade 'basalt blocks,' and some building and curb stone have been one of Sonoma County's important mineral assets for many years. The majority of the paving blocks used in street work in the cities of the state have come from quarries in this county, but this character of paving is now little used, and many of the quarries have been closed down for the past ten years or more.

Most of the rock, particularly along the ridge above Rincon Valley, is andesite, though it grades into basalt, and in other places to trachyte.

Although the output of paving blocks and cut stone has practically ceased, there has been an increase in the output of crushed rock, gravel and sand, and the stone industry continues to be the most important contributor to the mineral output of the county.

More than fifty quarries are listed and described in Report XIV, 1913-14, although many of them were idle at that time. A description of these idle properties will not be repeated in this report, but the location of some of the more important ones will be given.

Cloutts Bros. Quarry. (Grace Bros.) Located one and one-half miles northeast of Kenwood station, the scarred side of the hill being plainly visible from the valley near Kenwood. It was last operated by Grant, Smith & Co. in 1923, who supplied rock for a paving contract. All equipment has been removed.

Bibl: State Mineralogist's Report XII, p. 397; XIII, p. 635; XIV, p. 355.

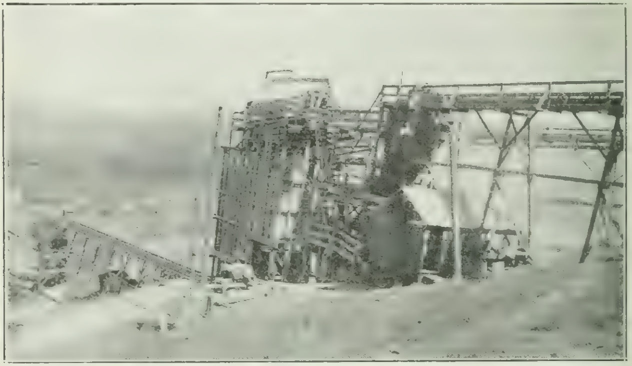
Craig Quarry. On a low rounded ridge, one and one-half miles northeast of Penn Grove. Idle.

Fairville Quarry. Near Fairville on the Northwestern Pacific Railroad. Idle.

Gray Quarry. In Sec. 6, T. 7 N., R. 7 W., three miles northeast of Santa Rosa. Idle.

Hein Bros. Basalt Rock Company (formerly Hein Construction Co.). Mark Hein, president; G. W. Walters, secretary; home office, Petaluma. This property consists of 20 acres located one mile south of Petaluma, covering a deposit of hard blue-gray basalt adjacent to the old Petaluma Rock Quarry but operated from the opposite side of the ridge. Production of crushed rock began here in August, 1925. The quarry face is about 300 feet above sea level, but the finished product is delivered to barges on Petaluma Creek by a series of conveyors having a total length of 900 feet with four drops. The last section crosses over the state highway and Northwestern Pacific Railroad tracks. Bunkers are provided here for loading railroad cars. Another bunker discharges to trucks. Outside storage is also provided. On account of its long hillside construction feature, few elevators are required.

In the quarry jack-hammer drills are used, with down holes. The broken rock is conveyed by a drag-line scraper to a No. 13A Telsmith gyratory crusher. The crusher discharge falls onto a 24″ conveyor belt which delivers to a scalper screen of the shaker type, which removes $\frac{1}{4}''$ material. The oversize goes to another screen that takes out 1″ material, which goes by 20″ belt to the stock pile or by the long conveyor system to the loading bunkers. The remaining oversize goes to a stock pile or by conveyor belt to the secondary crushing unit which contains one No. 4 and one No. 2 Telsmiths and an 8′ by 20″ rotary screen delivering $\frac{1}{4}''$ to $2\frac{1}{2}''$ material as desired. The discharge goes to a bunker or onto the long delivery belt. Practically any size product desired can be produced and delivered to stock pile or loaded direct to barge, railroad car or truck. There is a pumping plant at the slough for washing. The entire plant is driven by electric power furnished by the Pacific Gas and Electric Company; 290 horsepower being used.



General view looking down hill along line of screening and conveyor units at Hein Bros. Basalt Rock Company's Plant, Sonoma County.

Lower end, showing in distance conveyor over highway and railroad, Hein Bros. Basalt Rock Company's Plant, Sonoma County.

Ten men are employed, two in the quarry and eight in the plant, which has a capacity of 400 tons per day.

Helberg Gravel Plant. Fred Helberg, Schellville, owner. This plant is on Sonoma Creek, one-quarter mile from Schellville P. O. Gravel is taken from the creek bed with a drag-line hoist, using a LeClaire scraper. It is screened and the oversize crushed in a Telsmith gyratory. The following sizes are produced: 2″ to 1″; 1″ to ¼″ and ¼″ to dust. All of the material is washed by water pumped from the creek. Electric power is used, the connected load being 53 horsepower. Two men, with the owner, operate the plant.

Sand and gravel pumping unit at Independent Sand and Gravel Company's Plant, Sonoma County.

Hagermann Gravel Pit. This is a small plant owned by Ed. Hagermann, Schellville. It is located on Sonoma Creek, one-quarter mile from Schellville P. O. Gravel is taken from the creek bed and screened to various sizes. There is no crushing equipment.

Hutchinson Ranch Quarries. Several quarries were formerly operated on this property east of Santa Rosa.

Bibl: State Mineralogist's Reports X, p. 386; XI, p. 462; XII, p. 396; XIII, p. 634; XIV, p. 356; Bull. 38, pp. 343, 344.

Independent Sand and Gravel Co. J. P. Grady, president; Frank Allers, manager; home office, Forestville. The plant is located on the Russian River, one-half mile from Green Valley Station and about one and one-half miles from Forestville. Operations began in 1921. The system used here differs from most of the gravel plants in that the material is pumped by a 7-inch centrifugal pump mounted on a barge in the river to a pit on the shore below the plant. A grizzly at the pump discharge throws out any large boulders: A clam-shell bucket hoist picks up the sand and gravel from the pit and lifts it 100 feet to the screening and washing plant bin. Revolving screens segregate the material into sand, ⅜″ to ¾″ and oversize. The bunkers discharge to either trucks or railroad cars; the plant being on a spur track of the Northwestern Pacific Railroad. Electric power is used, the connected load being 120 horsepower. Three men are employed.

Laurent Bros. Quarry. Laurent Bros. of Kenwood formerly operated the Annabel group on the Hutchinson Ranch property.

Lawndale Quarry. Three miles northwest from Kenwood. Idle.

Lounibos Quarry. A deposit of trachyte tuff in Sec. 36, T. 6 N., R. 5 W., one mile east of Agua Caliente. Stone from here has been used for curbings, a county bridge at Schellville and in the cemetery at Sonoma. Idle.

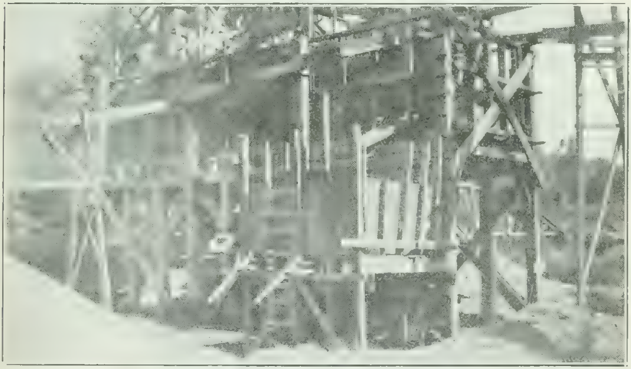
McDonald Ranch Quarries. The quarries on this property, which are among the oldest in the county, were first opened by McDonald in 1880. Cut stone, many millions of basalt blocks and crushed rock have all been produced here in the past. The stone was used in the Northwestern Pacific depot, St. Rose Church (1900), and the Carnegie Library (1903) in Santa Rosa. The property is two miles east of Santa Rosa at Baker Siding.

Bibl: State Mineralogist's Reports VIII, p. 635; X, p. 675; XII, p. 396; XIII, p. 634; XIV, p. 358; Bull. 38, pp. 163, 343, 344, 345.

Melitta Quarries. A group of basalt quarries one mile south of Melitta and five miles east of Santa Rosa. Idle.

Mirabel Gravel Company. Home office, Santa Rosa. This company, which has a lease on 40 acres covering bed and bars on the Russian River one mile from Forestville, began the production of 'bank run' and screened gravel in 1921. The plant is on a spur track of the Northwestern Pacific Railroad. Equipment consists of a LeClaire drag-line scraper, delivering to a hopper which discharges on to a belt conveyor with 150′ centers set at an angle and discharging to a bin at the top of the screening plant. The material is passed through two revolving screens which segregate sand, 'pea' gravel, $\frac{1}{8}''$ to $\frac{1}{4}''$, and $\frac{1}{2}''$ to $2\frac{1}{2}''$ gravel. The material is all washed, water being supplied by a four-inch pump through 500 feet of pipe. The bunkers discharge to railroad cars (spur holds eight cars) or to trucks. 'Bank run' gravel can be loaded direct to railroad cars at the rate of one car in 35 minutes. Electric power is used and three men are employed. The plant has a capacity of 400 tons per day. Operation is curtailed during periods of high water in the river.

Northwestern Pacific Railroad. Has a quarry in the Stony Point section, about half way between Sebastopol and Petaluma. Operated intermittently for ballast and fills. Stone from this place was used as early as 1858 in building some of the oldest buildings in Petaluma and in the construction of the Carnegie Library in 1904.



Gravel screening plant of Mirabel Gravel Company, near Forestville, Sonoma County.

Petaluma Rock Quarry. A basalt rock quarry, first opened in 1864; last operated by E. B. and A. L. Stone Co. Is in Sec. 3, T. 4 N., R. 7 W., one and one-half miles south of Petaluma. Idle and dismantled.

Rincon Exchange Gravel Pit. This is a small gravel plant on Santa Rosa Creek, two miles east of Santa Rosa on the Sonoma highway. Idle.

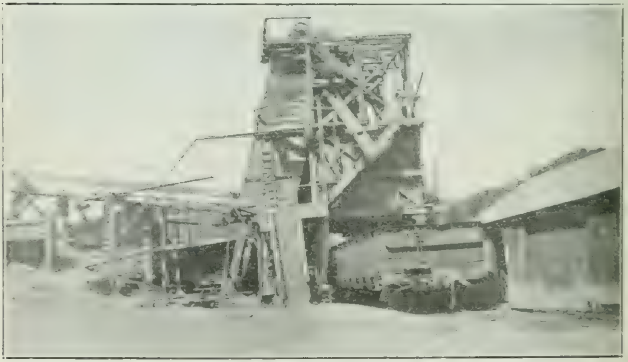
Roblar Mining Company. Formerly produced crushed quartz for chicken grit and fines for plaster work and sanding from a quartz vein in serpentine near Roblar Station on the Petaluma and Santa Rosa Electric Railway. The property is idle.

Bibl: State Mineralogist's Report XIV, p. 363.

Russian River Gravel Company. J. P. Grant, Healdsburg, owner. This plant is on a gravel bar on the Russian River, one-quarter mile east of Healdsburg. The plant was first built in 1906. It was enlarged in 1911 and again in 1924. The material is now excavated by a 5-yard drag-line scraper, which delivers the gravel to a revolving scalping screen above the crusher. The oversize is crushed. The material from this primary plant is then hauled in side-tipping cars by a Winsted gasoline locomotive to the secondary screening and washing plant where the the bunkers are situated. This unit is on a spur track of the Northwestern Pacific Railroad. The material is washed and segregated into various sizes here. There is bunker storage for 1400 yards of 'rock' and 2000 yards of 'sand' which can be taken up by belt conveyor. The capacity of the plant is 11 to 14 railroad ballast cars per day of screened material. Electric power is used throughout. Eight men are employed. The gravel is composed mainly of quartz, chert, and hard sandstone.

Bibl: State Mineralogist's Report XIV, pp. 363-364.

Excavator and conveyor to crushing unit, Russian River Gravel Company's Plant at Healdsburg, Sonoma County.



Screening and washing unit, with loading bunkers, Russian River Gravel Company's Plant, Sonoma County.

Schocken Quarry. Located on a steep hill one-half mile north of Sonoma, and first opened in 1876. About 1888 an average of 100,000 paving blocks per month were being shipped. It was later owned by Natomas Company of California and Coast Rock and Gravel Co. Idle.

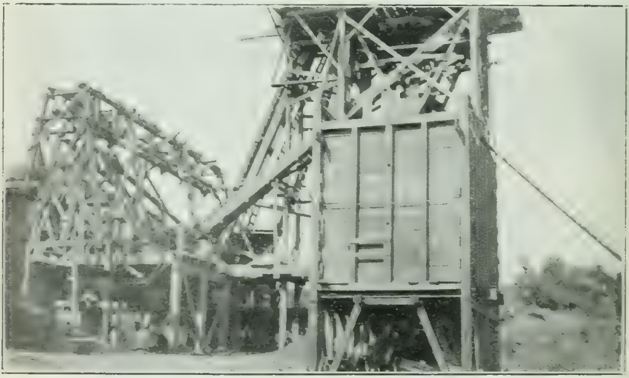
Bibl: State Mineralogist's Reports VIII, p. 635; XI, p. 463; XII, p. 397; XIII, p. 635; XIV, p. 360; Bull. 38, p. 345.

Plant of Sonoma Gravel Company, on Russian River, near Chianti, Sonoma County.

Sonoma Gravel Company. C. R. Powrie, president; L. E. Smead, secretary; home office, Healdsburg. This company's plant is located on the Russian River opposite Chianti Station of the Northwestern Pacific Railroad, ten miles north of Healdsburg. The gravel in the river and bars at this point has been used for several years but the present company began operations in April, 1926. The property comprises 47 acres covering the river bed and gravel bars. Only a few large boulders are encountered.

The slack-line excavating system is used, operating from a mast 96 feet in height. The bucket dumps into a bunker from which the material passes to a revolving screen. All over 2½″ goes to a Gates No. 3 gyratory in closed circuit with the screen. The 2½″ and under material is successively screened to ¼″ to dust; ¼″ to ½″, ½″ to ¾″; ¾″ to 2½″ sizes, which go to separate bins from which railroad cars or trucks are loaded. There is no outside storage. A separate drag-line hoist loads 'river run' material for ballast direct to railroad cars. All segregated material is washed by water pumped from the river. Electric power is used, a total of 215 horsepower being required. Seven men are employed.

Stony Point Quarry. W. A. Wilson, Petaluma Star Route, owner. This quarry is situated in the Stony Point district, one-quarter mile from the Petaluma and Santa Rosa Electric railway, and three miles a little west of south from Cotati. It was opened in 1922. The rock so far taken out is more or less altered and in places vesicular, but occasional lenses of dark, tough basalt are encountered. The plant is operated intermittently for road use. After shooting, the rock is trammed in ordinary mine cars to the crusher. The crusher run is elevated to a bin from which trucks are loaded. Electric power is used to operate the crusher and elevator.



Crushed rock plant at Taylor Rock Quarry, near Santa Rosa, Sonoma County.

Taylor Gravel Pit. John S. Taylor, owner, Santa Rosa. A drag-line excavator, gravel screening and washing plant is operated by Mr. Taylor on Santa Rosa Creek, two miles east of Santa Rosa on the Sonoma highway. There are bunkers for both fine and coarse gravel of various sizes from which trucks are loaded.

Taylor Rock Quarry. John S. Taylor, owner, Santa Rosa. This quarry is situated in the Melitta section, about three miles east of

Santa Rosa. During the past year two new faces have been opened and a better grade rock—a heavy dark-colored basalt—obtained. The rock is trammed to the crushing and screening plant, which is electrically operated. The primary crusher is a No. 5 Austin gyratory, which is supplemented by two smaller gyratories. All standard sizes of crushed rock are produced. Bunkers are provided for loading trucks. The plant was temporarily shut down at the time of visit, but is in practically continuous operation.

Titania Quarry. Two miles east of Santa Rosa. Idle.

Bibl: State Mineralogist's Reports XII, p. 396; XIII, p. 634; XIV, p. 365; Bull. 38, pp. 163, 345.

SULPHUR.

Native sulphur occurs at 'The Geysers,' but no commercial production has ever been made.

LOS ANGELES FIELD DIVISION.

W. BURLING TUCKER, Mining Engineer.

On account of unfinished field work, there is no report from the Los Angeles Division in this issue.

OIL FIELD DEVELOPMENT OPERATIONS.

By D. R. Bush, State Oil and Gas Supervisor.

From May 2, 1926, to and including July 31, 1926, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
ALAMEDA COUNTY:					
J. E. Burney Syndicate No. 1	19	2	4	1	
FRESNO COUNTY:					
R. H. Sayers	14	20	14	Arizona 8	Coalinga
Standard Oil Co.	25	20	14	105	Coalinga
KERN COUNTY:					
Belridge Oil Co	32	28	21	376-X	Belridge
Carneros Oil Co	31	28	21	1	Belridge
Carneros Oil Co	31	28	21	2	Belridge
Devils Den Products Co	24	25	18	4	Devils Den
Devils Den Products Co	23	25	18	5	Devils Den
Gross Drilling Co	26	30	24	4	Elk Hills
Pan American Petroleum Co	1	31	24	Crampton 4-I	Elk Hills
Standard Oil Co	27	30	24	122	Elk Hills
Union Oil Co	26	30	24	Elk Hills 15	Elk Hills
Union Oil Co.	26	30	24	Elk Hills 16	Elk Hills
Barnsdall Oil Co	28	27	27	Leutholtz 2	Kern River
Carissa Oil Co	28	27	27	1	Kern River
Carrec Oil Co.	11	28	27	1	Kern River
George F. Getty	14	28	27	Lehnhardt 5	Kern River
George F. Getty, Inc.	22	28	27	Tegeler 4	Kern River
George F. Getty, Inc	22	28	27	Tegeler 7	Kern River
Petroleum Securities Co.	28	28	27	1	Kern River
Superior Oil Co	34	27	27	Leutholtz 1	Kern River
Sure Oil Co.	26	28	28	1	Kern River
Union Oil Co.	35	27	27	Miller 1	Kern River
F. G. Wagner	34	28	28	16	Kern River
Wing and Skakel	34	28	28	1	Kern River
Universal Consolidated Oil Co	30	26	21	15	Lost Hills
Universal Consolidated Oil Co	30	26	21	16	Lost Hills
Associated Oil Co.	20	31	23	1	Midway
Associated Oil Co.	20	31	23	23	Midway
Balboa Oil Co.	24	31	23	52	Midway
Balboa Oil Co	24	31	23	53	Midway
California Petroleum Corp.	34	32	24	Dorothy 7	Midway
Carolina Western Oil Co	36	32	23	3	Midway
Hugh B. Evans, Inc.	4	32	23	4	Midway
Hugh B. Evans, Inc.	4	32	23	5	Midway
King G. Gillette	21	31	22	A-5	Midway
King G. Gillette	21	31	22	B-4	Midway
King G. Gillette	21	31	22	B-11	Midway
King G. Gillette	21	31	22	B-12	Midway
Honolulu Consolidated Oil Co	4	32	24	2	Midway
Honolulu Consolidated Oil Co	12	32	24	6	Midway
Honolulu Consolidated Oil Co	12	32	24	9	Midway
Honolulu Consolidated Oil Co	8	32	24	28	Midway
Honolulu Consolidated Oil Co	8	32	24	39	Midway
Honolulu Consolidated Oil Co	4	32	24	65	Midway
Honolulu Consolidated Oil Co	4	32	24	74	Midway
Honolulu Consolidated Oil Co	4	32	24	75	Midway
Honolulu Consolidated Oil Co	6	32	24	76	Midway
Honolulu Consolidated Oil Co	4	32	24	84	Midway
Midland Oilfields Co., Ltd.	34	31	24	Thornber 7	Midway
Pioneer Midway Oil Co.	30	31	23	8	Midway
Security Development Co.	15	31	22	12	Midway
Standard Oil Co.	29	31	23	1	Midway
Standard Oil Co.	29	31	24	2	Midway
Standard Oil Co.	29	31	24	4	Midway
Standard Oil Co.	29	31	24	5	Midway
Standard Oil Co.	29	31	24	6	Midway
Standard Oil Co	29	31	24	7	Midway
Standard Oil Co.	33	31	24	12	Midway
Standard Oil Co.	21	32	24	12	Midway
Standard Oil Co	3	32	24	36	Midway
Standard Oil Co.	17	32	24	37	Midway
Standard Oil Co.	19	31	24	45	Midway
Standard Oil Co.	19	31	24	46	Midway
Standard Oil Co	5	32	24	46	Midway
The United Oil Co.	19	31	23	Calidon 7	Midway
The United Oil Co	20	31	23	United 5	Midway

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
Western Production Co.	21	31	22	6	Midway
Bankline Oil Co.	6	11	23	10	Sunset
Beverly Oil Co.	6	11	23	9	Sunset
Blanck & Heasley	6	11	23	4	Sunset
Lewis Petroleum Co.	34	12	24	G-M 16	Sunset
John F. Lingo	10	11	23	1-A	Sunset
Midway Northern Oil Co.	32	12	23	14	Sunset
Midway Northern Oil Co.	32	12	23	15	Sunset
Pacific Oil Co.	30	12	23	93	Sunset
Standard Oil Co.	31	12	23	34	Sunset
Standard Oil Co.	31	12	23	52	Sunset
Standard Oil Co.	10	11	23	Rass 3	Sunset
Union Oil Co.	10	11	23	Boss 2	Sunset
Standard Oil Co.	27	11	20	Kern Co. Lease No. 2 24	Wheeler Ridge
Standard Oil Co.	27	11	20	Kern Co. Lease No. 2 25	Wheeler Ridge
Eliot M. Ashe	2	27	27	Ashe 1	
Blythe & Weatherwax	28	11	23	1	
George O. H. Buchner	20	26	28	1	
George O. H. Buchner	14	27	28	1	
W. H. Davis	13	26	17	1	
General Petroleum Corp.	29	27	28	1	
George F. Getty, Inc.	17	27	27	DePauli-Kane 23	
John Lucas and Associates	10	27	27	1	
Milham Exploration Co.	33	11	22	Pioneer 2	
Petroleum Securities Co.	8	27	28	1	
Shell Co.	21	11	22	San Emigdio 1	
Nelson G. Smith	10	26	27	1	
Union Oil Co.	4	27	28	Sarret 1	
LOS ANGELES COUNTY:					
Shell Co.	34	3	13	Reyes 34	Dominguez
Union Oil Co.	33	3	13	Hellman 13	Dominguez
Associated Oil Co.	7	2	14	Vickers 50	Inglewood
Standard Oil Co.	17	2	14	Baldwin 31	Inglewood
Standard Oil Co.	17	2	14	Baldwin 34	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 49	Inglewood
Standard Oil Co.	16	2	14	Stocker 6	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 11	Inglewood
Acme Petroleum Corp.	19	4	12	Damron 1-A	Long Beach
California Petroleum Corp.	13	4	13	Bryant 2	Long Beach
California Petroleum Corp.	19	4	12	Fields 11	Long Beach
Fisher Oil Co.	20	4	12	Dodge 2	Long Beach
Fred F. Fitch	33	4	12	1	Long Beach
Gem Oil Co.	13	4	13	3	Long Beach
A. T. Jergins Trust	19	4	12	18	Long Beach
A. T. Jergins Trust	19	4	12	19	Long Beach
J. D. Lauricella	20	4	12	1	Long Beach
L. J. McAlpine	13	4	13	McAlpine 4	Long Beach
Miller and Haley	25	4	13	1	Long Beach
J. G. Richardson & Charles A. Son	24	4	13	Richardson 5	Long Beach
J. G. Richardson & Charles A. Son	24	4	13	Richardson 7	Long Beach
Fred W. Roberts	29	4	12	2	Long Beach
San Martinez Oil Co.	29	4	12	Dillman 1	Long Beach
K. L. Smith	13	4	13	Smith 1	Long Beach
Union Oil Co.	30	4	12	Long Beach Community 13	Long Beach
The United Oil Co.	19	4	12	Hass 8	Long Beach
Baldwin-Stocker Oil Estates	1	2	12	5-B	Montebello
McGinley Oil Co.	6	2	11	22	Montebello
The St. Helens Petroleum Co., Ltd.	2	2	12	McDonald 1	Montebello
St. Helens Riverside Properties	2	2	12	Monterey 13	Montebello
Standard Oil Co.	2	2	12	Baldwin 61	Montebello
Standard Oil Co.	6	2	11	Baldwin 68	Montebello
Standard Oil Co.	2	2	12	Benedictine 1	Montebello
Superior Oil Co.	2	2	12	Masser 1	Montebello
Associated Oil Co.	34	2	14	Cypress 1	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 13	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 14	Rosecrans
Union Oil Co.	18	3	13	Howard Park 28	Rosecrans
Union Oil Co.	18	3	13	Howard Park 29	Rosecrans
Union Oil Co.	18	3	13	Rosecrans 8	Rosecrans
General Petroleum Corp.	5	3	11	21	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 24	Santa Fe Springs
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 39	Torrance
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 45	Torrance
Chanslor-Canfield Midway Oil Co.	16	4	14	Del Amo 49	Torrance
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 51	Torrance
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 57	Torrance
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 62	Torrance

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Chanslor-Canfield Midway Oil Co.	8	4	14	Del Amo 67	Torrance
Chanslor-Canfield Midway Oil Co.	8	4	14	Del Amo 73	Torrance
Chanslor-Canfield Midway Oil Co.	8	4	14	Del Amo 79	Torrance
Shell Co	8	4	14	Redondo Comm. 14	Torrance
Shell Co.	8	4	14	Redondo Comm. 15	Torrance
Standard Oil Co.	22	4	14	Marble Lease 13	Torrance
Superior Oil Co.	19	4	13	Torrance 45	Torrance
Superior Oil Co.	24	4	14	Torrance 64	Torrance
Pan American Petroleum Co	16	2	11	Chanchorena 1	Whittier
[illegible] Drilling Co.	16	2	11	1	Whittier
[illegible] Oil Co.	35	1	11	Merlo 1	
Julian Petroleum Corp.	24	3	15	Meyer & Platt 1	
[illegible] Corp.-Western Corp.	24	3	12	Strong 1	
Marland Oil Co	11	5	12	Bixby 2	
Petroleum Securities Co.	14	2	16	Sesnon 1	
Standard Oil Co.	11	1	17	Austin 1	
Union Oil Co.	24	2	15	Howland 1	
MONTEREY COUNTY:					
[illegible]	5	19	10	1	
Petroleum Securities Co.	27	23	13	White 1	
ORANGE COUNTY:					
Brea Canon Oil Co.	1	3	10	39	Brea Olinda
Fullerton Oil Co.	2	3	10	21	Brea Olinda
General Petroleum Corp.	1	3	10	Tonner 2-A	Brea Olinda
Shell Co	8	3	9	Columbia 40	Brea Olinda
The St. Helens Petroleum Co., Ltd.	18	3	[illegible]	Anderson 5	Coyote Hills
Julian Petroleum Corp.	10	6	11	Lambert 1	Huntington Beach
McKeon Oil Co.	10	6	11	Huntington 1	Huntington Beach
E. J. Miley	10	6	11	Pacific Electric 1	Huntington Beach
E. J. Miley	10	6	11	Pacific Electric 2	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 25	Huntington Beach
Standard Oil Co.	34	5	11	Huntington A-31	Huntington Beach
Standard Oil Co.	3	6	11	Huntington A-32	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B-47	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B-48	Huntington Beach
Standard Oil Co.	2	6	11	Huntington B-49	Huntington Beach
[illegible] Oil Co.	2	6	11	10	Huntington Beach
Superior Oil Co.	10	6	11	Jones 1	Huntington Beach
The United Oil Co.	2	6	11	Dabney 7-A	Huntington Beach
The United Oil Co.	2	6	11	Pacific 2	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H. B. 1	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H. B. 2	Huntington Beach
Julian Petroleum Corp.	21	6	10	Strowbridge B 2	Newport
General Petroleum Corp.	28	3	9	Thompson 1-A	Richfield
S. H. [illegible] Trustee	30	3	9	Kraemer-Keoughan 2	Richfield
[illegible] Drilling Co.	27	3	9	1	Richfield
Standard Oil Co.	29	3	9	Kraemer 2 22	Richfield
Union Oil Co.	29	3	9	Chapman 25	Richfield
Union Oil Co.	29	3	9	Coyle 6	Richfield
Union Oil Co.	29	3	9	Coyle 7	Richfield
Union Oil Co.	29	3	9	J. W. Newell 5-A	Richfield
Union Oil Co.	29	3	9	J. W. Newell 6	Richfield
California Pet. Developing Co	2	8	8	1	
RIVERSIDE COUNTY:					
[illegible]	11	2	4	1	
SAN DIEGO COUNTY:					
[illegible] Oil Corp.	24	13	4	Turner 1	
SAN LUIS OBISPO COUNTY:					
[illegible]	19	10	24	1	
SANTA BARBARA COUNTY:					
R. & G. Oil Co.	30	9	32	9	Cat Canyon
Standard Oil Co.	13	9	33	Palmer Union 1	Cat Canyon
[illegible]	--	4	26	2	Summerland
West Penn Producing Co	--	8	31	Shields 1	
SANTA CRUZ COUNTY:					
[illegible]	--	11	2	1	
SONOMA COUNTY:					
O. F. W. Drilling Co., Inc	--	5	6	1	
Shell Co	*	*	*	Murphy 1	

---

*Lot 270, Rancho Petaluma.

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
TULARE COUNTY:					
Federal Exploration Co.	15	22	24	Kinsella 1	
VENTURA COUNTY:					
O. R. Howard	5	3	19	Elkins 3	Bardsdale
Hassock Oil Co.	12	4	22	1	Ojai
Hess-Rue-Henderson Oil Co., Inc.	33	4	23	7	Ojai
Frank Shannon	8	4	21	1-A	Ojai
Henderson Petroleum Corp.	33	5	18	Kaar 2	Piru
Leonard Brothers	4	4	18	1	Piru
Ruth J. Bishop and Buckeye Union Oil Co.	34	5	19	2	Sespe
Border Oil Co.	8	5	19	1	Sespe
Oak Ridge Oil Co.	13	3	21	Harvey 18	South Mountain
Oak Ridge Oil Co.	13	3	21	South Mountain 9	South Mmountain
Associated Oil Co.	22	3	23	Hartman 5	Ventura
Associated Oil Co.	27	3	23	Lloyd 2-A	Ventura
Associated Oil Co.	27	3	23	Lloyd 32	Ventura
Associated Oil Co.	27	3	23	Lloyd 38	Ventura
Associated Oil Co.	27	3	23	Lloyd 45	Ventura
Associated Oil Co.	23	3	23	McGonigle 2	Ventura
Associated Oil Co.	26	3	23	V. L. & W. 1	Ventura
General Petroleum Corp.	22	3	23	Barnard 1-A	Ventura
General Petroleum Corp.	28	3	23	Barnard 2	Ventura
General Petroleum Corp.	28	3	23	Barnard 6	Ventura
General Petroleum Corp.	21	3	23	Barnard 7	Ventura
Miley Oil Co.	7	3	23	Casitas 2	Ventura
Shell Co.	28	3	23	Edison 7	Ventura
Shell Co.	28	3	23	Edison 9	Ventura
Shell Co.	28	3	23	Edison 10	Ventura
Shell Co.	28	3	23	Gosnell 12	Ventura
Shell Co.	28	3	23	Gosnell 13	Ventura
Shell Co.	28	3	23	Taylor 14	
Standard Oil Co.	20	2	22	Valentine 3	
Rio Grande Oil Co.	9	3	23	Canet 1	
Sentinel Oil Co.	36	2	21	1	
Standard Oil Co.	29	2	20	Camarillo 1	
Standard Oil Co.	17	2	22	Valentine 2	

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

GAS, GASOLINE AND PETROLEUM.

By A. H. RICKETTS, of the San Francisco bar.

The line of demarcation between oil and gas is indistinct. It is well recognized that each is of the series of hydro-carbons. It would be a clear perversion of language to hold that gas and oil are synonymous terms.[1]

The ultimate origin of casinghead gas is contemporaneous with the petroleum with which it is associated. The gas is essentially a mixture of natural gas and the vapors of the lighter components of petroleum.[2] Casinghead gas is the name given to the gas which flows from oil wells, and as a rule, comes from the same 'sand' or formation, as the oil. Its name is derived from the fact that it is taken from the well through the casinghead. It consists of a mixture of the lighter members of the methane series, namely, methane, ethane, propane, butane, pentane, etc., but heavier hydro-carbons than predominant in natural gas. Both natural and casinghead gas are mainly composed of hydro-carbons.[3] The statement sometimes is made that the gasoline in the casinghead gas is derived from the crude oil. This is incorrect when used in the sense that the casinghead gas takes gasoline from the crude oil.[4]

J. O. Lewis in treating of 'The Solubility of Gases in Petroleum' says:[5] "The gas held in solution by the oil is an essentially important factor in the recovery of oil from the formations in which it is found. 'Under the same conditions of temperature and pressure a particular oil will absorb a fixed proportion of a particular gas, but this proportion or coefficient of absorption, as it is called, varies with each oil and each gas. The gas is held absorbed in the oil in the same way that soda water is charged with carbon dioxide. The proportion of gas absorbed is increased under high pressures, in accordance with Henry's law of gases. Enormous quantities of gas are held in solution under the high initial pressure found in some oil wells. Some of the constituent gases are condensed at these high pressures just as in a compressor plant, and as long as high enough pressure is maintained, exists as liquids dissolved in the oil. Under such conditions the gas is not absorbed as a gas but as one liquid dissolved in another, and a much greater proportion of gas can be held in solution when in liquefied form than when uncondensed. Other gases (methane, ethane, and propane) are never liquefied at the pressures and temperatures in oil sands penetrated by wells, but are always found as gases dissolved or absorbed in the oil. These constitute the so-called dry gases.' ''

---

[1] Truby v. Palmer (Pa.), 6 Atl. 74.

[2] Westcott's Handbook of Casinghead Gas, (3rd ed.), p. 8.

[3] Id. p. 35.

[4] Id. p. 33.

[5] Bulletin 48, p. 11.

Mr. Lewis also shows a table which indicates the physical properties of various hydro-carbons and the constituent elements of casinghead natural gas. From this table the following facts are apparent: Petroleum contains some of the same hydro-carbons as are contained in dry gas. It also contains some of the same as wet gas or casinghead gas. All three contain those hydro-carbons from which gasoline is made, in varying proportions.

The usual classification with reference to the gas is whether or not the gas is dry or the gas is wet. Bacon and Hamor, in their manual[6] give a glossary of all the terms used in the oil industry. 'Natural Gas' is defined as a 'gaseous product arising from petroleum wells.' Natural gas is divided into two classifications. 'Dry Natural Gas' and 'Wet Natural Gas.' Dry natural gas is defined as follows: 'Natural gas which does not contain an appreciable amount of readily condensible gasoline. It is not usually associated with petroleum.' Wet natural gas is defined as follows:

'(1) Natural gas from which gasoline can be extracted in sufficient quantities to warrant the installation of a plant.

'(2) Natural gas which contains readily condensible gasoline.'

It will be observed, therefore, that natural gas is subdivided into these two classes and that there is no atomic or elementary difference, except that one contains sufficient gasoline to be readily condensible, while the other does not. In other words, they both contain gasoline in the uncondensed form, but one contains such a small amount of condensible gasoline it cannot be readily condensed, and is therefore not commercial. It is regarded as dry gas.

Petroleum has long been popularly regarded as a mineral oil, as its derivation indicates. The word means 'rock oil,' an oily substance so named because found naturally oozing from crevices in rocks.[7] Petroleum oil is a fluid found in the porous sand-rocks of the earth.[8] The meaning of the word 'gas' is neither ambiguous nor uncertain, but is well understood.[9] Gas coming from an oil well, passing through the casing, making its exit through the head of the casing, receives the designation of 'casinghead gas,' which is no other than 'gas from an oil well.'[10] The language 'if the party of the second part shall market any gas from any well producing gas * * * applies to gas marketed, whether from a well producing gas only or from a well producing both oil and gas.'[11] Gas is not an exhalation of oil, nor is it held in solution by the oil to any considerable extent. Gas and oil are in their chemical composition, no doubt, both hydro-carbons, but are distinct and different products.[12] A sale of oil, gas and mineral rights which obligates the purchaser to deliver to the seller one-eighth part of all oil produced and saved from the land, does not cover gas, gasoline, or carbon produced from the gas; gasoline may be of the same generic species or family of minerals as that of oil, but it cannot be classed as oil or substituted for oil, within the intent and meaning of the word 'oil' as used in the contract of sale.[13] Gasoline manufactured from casinghead gas is not 'oil' as that term is used in an oil and gas lease.[14]

---

[6] American Petroleum Industry.

[7] Burke v. S. R. R. Co., 234 U. S. 669.

[8] Wagner v. Mallory, 169 N. Y. 501, 62 NE 584.

[9] Burton v. Forrest Oil Co., 204 Pa. St. 349, 54 Atl. 266.

[10] Mussellem v. M. P. Co., 107 Okla. 183, 231 Pac. 526.

[11] Withington v. Gypsy Oil Co., 68 Okla. 138, 172 Pac. 634.

[12] Bernard etc. Co. v. Farquharson, 1913 B Ann. Cas. 1212 English Privy Council, July 31, 1912, Canada Case.

There is a confusion of terminology in the use of 'casinghead gas,' 'casinghead gasoline' and 'gas from an oil well.' Gasoline or casinghead gasoline is produced from casinghead gas, or gas from an oil well, by a process of manufacture or distillation.

'Casinghead gas' and 'gas produced from an oil well' are the same substances, sometimes taking the name of the head of the casing through which it escapes, being the casinghead, and called 'casinghead gas,' and sometimes taking the name 'gas from an oil well.'[15]

Neither casinghead gas nor gasoline manufactured therefrom is a component part of crude petroleum in the well, and the right to take the same under the term 'oil,' as used in the granting clause of a lease, is denied, because the word 'oil,' as used in an oil and gas lease, means the oil produced from a well or crude petroleum in its natural state.[16]

Gasoline as such, never comes from the mouth of the well. Sometimes when the flow of gas is impeded through the pipe lines leading from the casinghead to the plant or other points, there is a 'drip' formed. This is occasioned by the heavier hydro-carbons in the gas coming in contact with the cold section of the line. The liquid so formed is negligible.

In Westcott's Handbook of Casinghead Gas[17] may be found data from which one will be enabled to form an idea as to the machinery and processes employed in the manufacture of casinghead gasoline, and will see that casinghead gasoline is the result of a process of manufacture and that it is not a substance that drips out of the gas like water from a sponge, as some of the authorities indicate.

COPPER IN CALIFORNIA.

By C. A. Logan, Mining Engineer.

History.

Copper mining in California has occurred in three cycles, each of which has affected in general all the mines of the state, but each especially marked by the development of some particular district. The metal was known in the fifties in many counties of the state, but copper mining did not begin until 1860, when the discovery of the Napoleon Mine in southwestern Calaveras County initiated the first commercial production. During the period 1861-1869 the Napoleon, Union, Keystone, Empire, Campo Seco and smaller mines of Calaveras County were developed and produced ores containing from 12% to 25% copper. Only good grade ore could be handled because of the expense of marketing. Ore had to be taken by team, steamer and later by rail to San Francisco for transshipment to eastern refineries or to Swansea, Wales; but a few small reverberatory and blast furnaces were built in the state and were producing matte before the latter year. Other counties became productive, as visiting miners returned to their homes from the Calaveras mines and took up the search. Production was established in practically every county on the western slope of the Sierra Nevada, from Tulare at the south to Plumas. Several of the Coast counties shared in the activity, Del Norte, in the extreme northwestern end of the state, ranking second to Calaveras. The Union, Empire and Keystone mines of Calaveras County, now consolidated and producing under the Calaveras Copper Company, produced 125,739 tons of ore assaying 10% copper or better, between 1861 and 1869. The price of copper fell to a point where the mines of this state could make little or no profit and most properties lay idle between 1869 and 1880. The mines of the Foothill Copper Belt had yielded their richest ores previous to this depression, but the great deposits of Shasta County had remained nearly untouched and their size was not realized by the few men who had prospected there.

---

[13] Wilkins v. Nelson, 155 La. 807, 99 So. 607.

[14] Mussellem v. M. P. Co., *supra.*[10]

[15] Id.

[16] Mullendore v. Minnehoma Oil Co., Martin's Oil & Gas Legal Service, Vol. 6, No. 2, p. 136, decided by the Commission of Appeals, State of Okla., Nov. 12, 1924.

[17] (3rd ed.) p. 277, et seq.

The prominent gossan outcrops of the Shasta Copper Belt were not recognized for many years as the cappings of important copper deposits. The Iron Mountain Mine was located in the early sixties as an iron mine, and so held until 1879, when gold and silver were found in the gossan by James Sallee, who operated it for these metals. Its career as a copper mine began in 1895, marking the advent of the second cycle of copper mining. The early work at the Bully Hill and Ingot mines was also for gold and silver.

The region by this time had a railroad passing through the copper belt, limestone and quartz were available nearby for flux and blast furnaces were built, so that it was possible to treat at a profit the large but comparatively low grade orebodies. Shasta County became the principal copper producer of the state. Between 1896 and 1925, inclusive, the mines produced 661,530,103 pounds of copper from a total of over 6,000,000 tons of ore. The principal producing properties were the Mammoth, Iron Mountain, Balaklala, Golinsky and Shasta King on the west side, and the Bully Hill, Rising Star and Afterthought on the east. The collapse of the copper market at the end of the war, and the continued low price of copper, has resulted in the practical cessation of copper mining in that district. Production during the war was stimulated to the point where most accessible reserves of copper were exhausted. Remaining proved orebodies are probably too low grade for exploitation under prevailing costs and at the present market price for the metal. The blast furnaces of the Mountain Copper Company at Keswick and of the Mammoth Copper Company at Kennett have been dismantled. Copper at present is produced in Shasta County principally from the Rising Star Mine at Bully Hill and the Afterthought Mine at Ingot, where the ores are worked chiefly for their zinc content. The Balaklala Mine is being reopened by the Mason Valley Mines Company, as the type of ore found there is needed at their Thompson smelter.

The third and latest development of copper mines in California has been along the Plumas Copper Belt in Plumas County, where the Engels Group and the Walker Mine are the chief producers. Many smaller mines in the same section are idle at present. Engels and Superior mines were developed by Engels Brothers over a period of many years, and became important producers in 1915. The ore from the consolidated groups was treated in the first oil flotation plant operated on a commercial scale in California, as the sole means of concentration. This plant has been enlarged several times and has an ultimate capacity of 1500 tons a day. In recent years its output has been averaging over 1,000,000 pounds of copper a month, reaching 1,250,000 pounds monthly at times.

Walker Mine, operated by a subsidiary of Anaconda Copper Company, is 17 miles south of Engels. While the flotation plant here has less than half the capacity of that at Engels, the annual production does not lag far behind, amounting to 11,301,159 pounds for the year ending June 30, 1924. The copper output of the county, coming almost entirely from these two groups, amounted, in 1925, to 26,950,029 pounds. Besides the counties mentioned, where the bulk of our copper production has occurred, smaller and irregular production has been made from Trinity, Siskiyou, Placer, Inyo, San Bernardino and other counties. The Island Mountain Mine in southwestern Trinity County is the only present producer of any importance in this list.

Geology of Copper Deposits.

The mines differ considerably as regards geology and types of ore. In the workings of the Calaveras Copper Company (the old Keystone, Empire and Union mines) the ore is chalcopyrite with more or less pyrite and is deposited typically along seams in black Mariposa (Jurassic) slate, in the form of lenses with their long axes parallel to the dip and strike of the bedding planes of the slate. The main ore body is 600 feet long, averaging 15 feet wide, dips 61 degrees northeast and strikes northwest. Serpentine lies on the footwall of the slate and amphibolite schist, or meta-diabase, on the hanging wall. A granodiorite dike, said to carry up to 1½% copper, has been noted as an intrusive in the slate. The main orebody averages 4% copper but at times rich bunches of chalcopyrite, carrying as much as 20% copper, are found. Smelter returns show no gold, and only one ounce of silver for each 980 pounds of copper. Present work is through a shaft 1250 feet deep on the dip.

Other past producers in the same county, such as the Penn Mine and the Napoleon Mine, show lens-shaped orebodies in amphibolite or meta-diabase, with the ores carrying gold, silver and zinc as well as copper. The Calaveras Copper Company is the only operator not having gold or silver in their ore sufficient to aid them.

The Engels deposit in Plumas County was first described by H. W. Turner and A. F. Rogers as a magmatic segregation in norite-diorite, which was probably a differentiation product of the granodiorite batholith of the Sierra Nevadas. L. C. Graton and D. H. McLaughlin later expressed the opinion that the ore minerals were introduced after the rock had solidified and had suffered notable dynamic and structural changes. The Engels ore is generally low grade and disseminated; in the adjoining Superior Mine, owned by the same company, the ore is deposited largely along joint planes and is clearly secondary. The oxidized zone showed a leached rock, stained by malachite, limonite and chrysocolla. It was irregular in its lower limits, merging into chalcocite and carbonates. Below this the zone of sulphide enrichment was 25 feet thick, yielding chalcocite carrying 16% to 20% copper. Lower grade bornite ore appeared at a depth of 100 to 130 feet. Pyrite is absent or nearly so. The average length of the Engels orebody is 800 feet, average width 60 feet with no naturally well-defined walls. The average ore milled (the mixed product of the two mines) contains 2¼% copper, a little gold and silver. No. 10 tunnel, completed in 1925 at a cost of $400,000, has a depth of 1262 feet. Engels' total production to date has been about 110,000,000 pounds of copper.

At the Walker Mine, second largest copper producer in the state, the vein is a strong well-defined quartz-filled fissure in hard diorite walls. On No. 3 level the vein was 20 feet wide, and on No. 4 level 45 feet wide, and the ore-shoot was 900 feet long. A high-grade streak five to six feet wide and 140 feet long on No. 4 level, carried 15% to 17% copper. Chalcopyrite is most prominent, but bornite occurs, and pyrite is common. The gangue contains barite as well as quartz. The ore runs 3½% to 4% copper, 0.6 ounce silver and 0.1 ounce gold per ton. No. 8 tunnel, at an elevation of 6200 feet above sea-level, is the main working level, giving a depth of 800 feet.

In Shasta County's copper belt, the orebodies occur in the Bully Hill and Balaklala rhyolites. The orebodies are roughly lens-shaped, occupying shear zones, and ranging from a few inches to 100 feet wide. Their age is thought to be Jurassic. The Mammoth orebody was 800 feet long and 200 feet deep, consisting of flat-lying lenses. It averaged 3% copper and $2 per ton in gold and silver, the principal minerals contained being pyrite, chalcopyrite and sphalerite. Another example is the immense pyrite deposit of the Mountain Copper Company's Hornet Mine, mined as a source of sulphuric acid, and carrying only 0.7% copper.

At Bully Hill and Ingot, the ores of the mines formerly worked entirely for copper have shown in later years an increasing amount of zinc. It is a complex, finely disseminated ore, carrying an average of 16% zinc and 3% copper, with 5½ ounces of silver and 0.03 ounce gold per ton, at the Afterthought Mine. In the Rising Star Mine at Winthrop the zinc content of the ore reaches 22%. Both properties are being operated by California Zinc Company. Depths of 800 and 1100 feet, respectively, have been reached.

Besides these developed and producing districts there are promising deposits in Siskiyou County, notably the Grey Eagle Mine near Happy Camp and the Blue Ledge Mine in Elliott Creek district, near the Oregon state line. Numerous gossan outcrops, showing copper, but only slightly prospected occur throughout the western and northern parts of the county. The region of these mines has no railroad and the character of the country is such that mineral products and timber are the only probable sources of revenue likely to be developed.

Milling and Smelting; Present Status of Operations.

California copper mines have been handicapped from early days by distance from smelters and markets. In the sixties ore was hauled by teams even from such remote districts as Alpine County, on the Nevada State line, across the Sierra Nevadas to Sacramento for shipment to the east or abroad by water. In Calaveras County, mines are some distance from railroad. Smaller properties shipped ore, 10% ore being about as low grade as could be handled, though this varied with distance from railroad. Both the Penn Mine at Campo Seco (now idle), and the Calaveras Copper Company, have operated blast and reverberatory furnaces. As they are outside the National Forests and not in a farming country, they were not molested. The latter company has lately put a new reverberatory furnace in commission. Ore is concentrated by oil flotation, giving a product containing 18% copper which is sintered in a Dwight & Lloyd sintering machine, smelted, and matte treated in converters and blister copper shipped to Tacoma. The blast furnace is kept to smelt ore containing 10% or more of copper. The flotation plant can handle 400 tons of 4% ore daily.

Agitation that arose in Shasta County forced the installation of bag houses at the smelters. The semi-pyritic process of smelting was used at Kennett, where the smelter capacity was 2200 tons, the ore averaging 3% copper in recent years. No smelters are in commission in that county, the last named having been the last in operation, but now being in process of wrecking.

Numerous methods for the separation of copper and zinc have been tried upon the ores at Ingot and Bully Hill, where in late years zinc has become the principal metal. At present, California Zinc Company is operating a bulk flotation plant at Winthrop, where ore from both the Afterthought and Rising Star Mines is concentrated. The product carries 43% to 49% zinc, about 4% copper, 7% to 11% iron, 1.5% lead and 2.3% silica. It is shipped to Belgium for separation. During flotation treatment, about one-half the pryite is dropped by alkalizing the pulp.

During the early years of development at Engels, the mine was separated by 26 miles of rough mountain road from the nearest point on the Western Pacific Railroad. A blast furnace was built in 1911, but was never used because of objections by the United States Forest Service. A minerals separation flotation plant was built in 1914 and has subsequently been enlarged to a working capacity of about 1000 tons a day, with an ultimate capacity of 1500 tons daily. The Indian Valley Railroad, 22 miles long, was built to the mine in 1916, being financed largely by the mining company. Concentrate carries 30% copper, 0.08 ounce gold and 8 ounces to 10 ounces silver per ton. This mine is at an elevation of 5263 feet in a well-timbered country.

Concentrate from the Walker Mine's flotation plant is delivered over their aerial tramway, nine miles long, to the Western Pacific Railroad at Spring Garden for shipment to the Utah smelter.

Besides these plants, Mountain Copper Company maintains a smelter at Martinez where they handle pyrite cinder for its copper content, after it has been treated for the manufacture of sulphuric acid. The ore comes from their Hornet Mine, in Shasta County.

Conclusion.

California copper mines operate at comparatively high costs. There is consequently no incentive for developing new properties with present market prices for copper, although conditions do justify the maintenance and operation of such plants as are now in commission. The copper production of the state in 1925, according to the records of the California State Mining Bureau, was mostly from three counties, whose principal active mines have been mentioned above, namely: Plumas County, 26,950,029 pounds; Shasta County, 14,565,967 pounds, and Calaveras County, 4,906,650 pounds. Production in Plumas County is increasing, and this district promises to continue as the largest producer for some time. The extent of the Plumas copper belt has not been outlined. The two principal mines are 17 miles apart, with many copper prospects but no real development between them. Shasta County has unexplored areas possibly containing future mines. Siskiyou County has two developed mines and numerous prospects, all too far from present railroads to be operated at the present price of copper. The mining regions of this county are all within the National Forests, where blast furnaces would not be permitted. A railroad is needed to open these mines.

Mention should be made of the numerous other copper possibilities of the state, there being a great number of small mines, only superficially developed, that can produce copper whenever the price may warrant.

ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Personnel.

There have been no changes of personnel to be noted during the past quarter.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Summary of Operations, California Oil Fields Vol. 11, Nos. 8 and 9, February and March, 1926, respectively.

Commercial Mineral Notes: Nos. 38, 39, 40, 41, April-July (inc.).

These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale,' issued in the form of a mimeographed sheet, monthly. It is mailed free of charge to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains in addition to its correspondence file and the library, a mine report file which includes reports on some 7,500 mines and mineral properties in California.

During the period covered by this quarterly report, there were 1768 letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

Walter W. Bradley, Deputy State Mineralogist.

STATISTICS.

Data on the 1925 production of several of California's minerals were given in the April issue of Mining in California, and some additional ones are presented herein. Copy of the complete annual report for that year is now being prepared and will shortly go to the printer, as Bulletin No. 97 of the State Mining Bureau.

COPPER.

Copper is second only to gold among the metals produced in California. The output for 1925 amounted to a total of 46,968,499 pounds of recoverable metal valued at $6,669,527, a slight decrease from the 1924 figures of 52,089,349 pounds and $6,823,704. The average price for 1925 being higher (14.2¢ against 13.1¢ per pound) than in 1924, the drop in total value was not as great in proportion as the decrease in quantity. The average price in 1923 was 14.7¢ per pound.

As for several years past, Plumas County ranked first for 1925 with an output of 26,950,029 pounds; Shasta, second, with 14,565,967 pounds; and Calaveras, third, with 4,906,650 pounds.

Distribution of the 1925 copper output, by counties, was as follows:

Copper Production, by Counties, 1925.

County	*Pounds*	*Value*
Calaveras	4,906,650	$696,744
Inyo	73,003	10,367
Mono	1,020	145
Plumas	26,950,029	3,826,904
Riverside	23,134	3,285
San Bernardino	6,249	888
Shasta	14,565,967	2,068,367
Trinity	439,766	62,447
Amador, Butte, Kern, Lake, Los Angeles, Nevada, Orange, Placer*	2,681	380
Totals	46,968,499	$6,669,527

* Combined to conceal output of a single operator in each.

GOLD

The production of gold in California in 1925 totaled 632,035.31 fine ounces, worth $13,065,330, being a decrease of 4,104.41 fine ounces from the 1924 yield. This was divided, $7,969,186 from the 'deep' or lode mines, and $5,096,144 from placers (mainly by the dredgers). As the State Mining Bureau has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Mr. J. M. Hill of the Division of Minerals and Statistics, U. S. Bureau of Mines.

The largest gold production for 1925 is reported from Yuba County, with an output of 124,354.23 fine ounces ($2,570,630); Amador County with 113,105.63 ounces ($2,338,101), was second; Nevada County, with 111,533.74 ounces ($2,305,607), third; followed by Sierra and Sacramento in fourth and fifth places respectively. It will be noted that Yuba County regained its place in first rank which it surrendered to Nevada

County in 1924. The Yuba County production is almost entirely from dredges, while that from Nevada County is mainly lode gold.

Distribution of the 1925 gold production, by counties, was as follows:

Gold Production, by Counties, 1925.

County	*Value*
Alpine	$219
Amador	2,338,101
Butte	355,289
Calaveras	652,433
Del Norte	681
El Dorado	40,212
Fresno	25,056
Humboldt	13,142
Inyo	43,774
Kern	135,545
Lassen	1,130
Los Angeles	409
Madera	2,366
Mariposa	192,810
Merced	289
Mono	5,503
Monterey	998
Napa	195
Nevada	2,305,607
Orange	52
Placer	121,785
Plumas	249,540
Riverside	3,687
Sacramento	1,302,320
San Bernardino	157,374
San Diego	5,134
San Luis Obispo	840
Shasta	235,013
Sierra	1,373,705
Siskiyou	180,120
Stanislaus	171,742
Trinity	424,037
Tuolumne	155,592
Yuba	2,570,630
Total value	$13,065,330

LEAD.

Production of lead in California in 1925 increased approximately 40% in quantity and 60% in value over the preceding year. As in the past, the principal output was from lead-silver ores in Inyo County. The total recoverable lead in ores shipped from Californian mines in 1925 amounted to 7,352,422 pounds valued at $639,661, compared with 4,984,387 pounds and $398,751 in 1924. This, in turn, however, was slightly less than the 1923 yield. The average price of lead in 1925 was 8.7¢ per pound as against 8.0¢ in 1924, 7.0¢ in 1923, and 3.9¢ in 1913.

The 1925 production was distributed by counties as follows:

Lead Production, by Counties, 1925.

County	*Pounds*	*Value*
Inyo	6,301,105	$548,196
Mono	22,488	1,957
Riverside	135,872	11,821
San Bernardino	61,480	5,349
Shasta	647,886	56,366
Amador, Butte, Calaveras, Los Angeles, Nevada, Orange *	183,591	15,972
Totals	7,352,422	$639,661

* Combined to conceal output of a single operator in each.

NATURAL GAS.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necessary to approximate the output of many of the operators in the oil fields, estimated on the number of lights, and on the number and horsepower of gas engines and steam boilers thus operated. The figures here given are for gas utilized locally and also that sold for distribution to consumers; and we consider are not over-estimated, particularly in the six oil-producing counties. It must be remembered that several of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable, nor is it often possible to have pipe-line facilities available to handle the gas accompanying the early gas production in newly developed fields. Wherever feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam-driven plants.

The most notable gas developments in California in recent years have been in the Elk Hills and Buena Vista Hills in Kern County, northeast of the Midway district, and in the new oil fields in the Los Angeles basin, Los Angeles and Orange counties.

Production and Value.

There is rather a wide variation in prices quoted for natural gas because a considerable part is used directly in the field for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have placed a valuation on the gas that was thus used in 1925 gave from 3¢-25¢ per 1000 cubic feet, at the well. From the totals shown in the tabulation following herein, the average value for all fields in 1925 works out at approximately 8.2¢.

Approximately 7000 cubic feet of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4000 cu. ft. per 24 hr. are consumed by a 25-h.p. engine and 63,700 cu. ft. per day for heating a 70-h.p. steam boiler, which figures have been utilized in compiling this report, in those cases where gas was not metered.

Natural Gas 'Consumed,' or Utilized for Fuel, 1925.

County	*M cu. ft.*	*Value*
Fresno	1,515,889	$116,711
Kern	45,649,845	2,290,608
Kings	740	440
Los Angeles	98,226,700	8,704,894
Orange	26,324,369	2,324,014
Santa Barbara	2,545,208	248,708
Tulare	280	175
Ventura	20,144,646	1,953,163
Butte, Humboldt, Lake, Mendocino, Sacramento, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Sutter, Yuba *	312,247	251,369
Totals	194,719,924	$15,890,082

* Combined to conceal output of a single operator in each.

The above totals for 1925 compare with 209,921,596 cu. ft., valued at $15,153,140 in 1924. The only important increase in quantity in 1925 was made by Ventura County, which shows 20,144,646 M cu. ft. worth $1,953,163 as against 5,995,760 M cu. ft. and $633,352 in 1924. This was due to exploitation of deeper oil sands in the Ventura field. Fresno County showed a slight increase, Los Angeles, Orange, and Kern counties, in the order named, utilized somewhat smaller quantities of natural gas; but, with the exception of Los Angeles, there was a larger recovery of natural-gas gasoline from the gas treated.

Gasoline from Natural Gas.

More or less gas usually accompanies the crude petroleum in the oil fields, and such gas carries varying amounts of gasoline. A total of 163 plants by 83 operating companies or individuals were in operation in 1925 recovering gasoline by compression or absorption from this 'casing-head' gas. After the gasoline is extracted the remaining 'dry gas' so far as practicable is taken into pipe lines, by which it is distributed to consumers, both domestic and commercial.

In certain of the oil fields, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to its transmission to consuming centers through the gas pipelines. Some concerns market the casing-head gasoline separately, others blend it with distillery gasoline, while others turn it into the oil pipelines, thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery where it is later regained. A total of 301,755,000 gallons of casing-head gasoline valued at $39,288,500 from all fields was reported as made during 1925, compared with 228,781,000 gallons valued at $22,269,955 by 82 operators and 137 plants in 1924. It was distributed by counties, as follows:

Natural-Gas Gasoline Recovered, 1925.

County	*No. Plants*	*Gallons*	*Value*
Fresno	1	587,000	$76,427
Kern	44	59,030,000	7,685,706
Los Angeles	76	177,920,000	23,165,184
Orange	29	45,040,000	5,864,208
Santa Barbara	4	6,891,000	897,208
Ventura	9	12,287,000	1,599,767
Totals	163	301,755,000	$39,288,500

The usual recoveries of gasoline from natural gas vary from ½ gal. to 3 gal. per 1000 cu. ft. of gas handled, the average being about 1 gal. per 1000 cu. ft. A recent report by Mashaw & Swanson[1] gives the average recovery for 1925 as 1.281 gallons per 1000 cu. ft. of gas treated. Their figures show the following production, by methods:

Natural-Gas Gasoline Production, 1925, by Methods.

(Per U. S. Bureau of Mines)

Method	*Gallons*	*Recovery (Gal. per M cu. ft.)*
Oil absorption	176,659,197	1.117
Compressor	6,718,091	1.369
Combination compressor and oil absorption	86,156,130	1.436
Combination oil and charcoal absorption	33,367,546	1.539
Drip	279,113	----
Totals	303,180,077	1.281

PETROLEUM.

The crude oil production of California for 1925 amounted to a total of 232,492,147 barrels of clean oil, valued at $330,609,829 at the well. This total of quantity is compiled from the monthly production reports filed by the operators with the State Oil and Gas Supervisor, to which have been added figures for the output of a number of small operators in the old Los Angeles City Field not under the jurisdiction of the Supervisor, and a small production in San Mateo County which was also not reported to that office.

---

[1] Mashaw, J. W., & Swanson, E. B., Statistical summary of the California petroleum industry 1925: U. S. Bureau of Mines, 1926, p. 27.

The question of the value of the crude oil yield at the well is a difficult one to settle with exactitude, principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil which they send direct from well to plant, hence much of the crude oil is not sold as such. The values used in the statistical reports of the State Mining Bureau since 1914 have been derived from averages of actual sales of crude oil of all grades in each field of the state, and these averages applied to the total yield of the respective fields. This we feel is a safer measure of commercial values than market quotations, because quotations do not always mean sales. This is particularly true on a rising or a falling market.

A comparison of the sales and quotations averages for the past ten years reveals a number of interesting developments, among which may be noted the following: On a rising market the average sales price for the year will be lower than the average of quotations; and on a falling market the average sales will be higher than the quotation average. This is probably due, in part at least, to sales under time contracts.

Features of 1925.

The noteworthy features of the year 1925 in the oil industry of California were the higher prices prevailing and the increase in production due to the newer fields of Inglewood, Rosecrans, Dominguez, and Ventura, though this increase was partly offset by the increased amount of closed-in production and partly by decline in some of the older fields, particularly Long Beach.

Summarizing the data for the year, the State Oil and Gas Supervisor[1] presented the following figures:

"The total production of the state for the last six months of 1925 was 120,623,010 barrels of oil and 53,519,125 barrels of water. The production of oil for the year 1925 was, therefore, 232,334,238 barrels, an increase of 3,625,767 barrels over 1924. Production increased, notwithstanding that the amount of closed-in production in the state increased during the latter half of the year. The increased production was principally from four fields as follows:

Field	Increase of 1925 over 1924 production
Inglewood	18,365,356 barrels
Rosecrans	7,191,880 barrels
Dominguez	6,767,640 barrels
Ventura	5,182,597 barrels
Total	37,507,473 barrels

This increase was partly offset by the increased amount of closed-in production, and partly by decline in some of the older fields, notably Long Beach, which produced 19,527,931 barrels less in 1925.

"The production of oil for the last half of 1925 was 8,911,782 barrels more than for the first half. Water production decreased 1,760,012 barrels during the same periods. * * *

"The estimated closed-in production remained constant at about 25,000 barrels daily during the first five months of the year, but in June additional production from Elk Hills and Midway-Sunset was closed in, and the amount increased steadily in those and other fields to 60,454 barrels daily in December. * * *

"*Storage and Price Changes.*

"The total crude and refined petroleum in storage in Pacific coast territory at the end of 1925 was 153,796,682 barrels according to the American Petroleum Institute. The increase in storage during the year amounted to 28,774,718 barrels compared with an increase in 1924 of 8,294,522 barrels. The total amount of crude and refined oil shipped to eastern ports during 1925 was 27,937,000 barrels or 19,690,000 barrels less than the 1924 shipments.

"Prices of crude averaged higher in 1925 than in 1924. The prevailing price range of $1 to $1.82 per barrel in January was increased in February to a range of $1.25 to $2.40 per barrel and continued at that level until September 21, when it was reduced, ranging from $0.90 to $2.30 per barrel. A further reduction was made October 27 when the range in price was $0.75 to $2.30, affecting only the heavier grades. These prices continued for the remainder of the year.

---

[1] Bush, R. D., Resumé of oil field operations in California in 1925: Cal. State Min. Bur., 11th Ann. Rep. of State O. & G. Super. No 8, Feb. 1926, pp. 5 and 6.

"*Drilling and Development.*

"During 1925, 1359 wells were reported to the State Oil and Gas Supervisor as ready to drill, as compared with 1352 new wells in 1924. Of the total number 107, or 8 per cent, were wildcat wells. No new fields of importance were discovered, but considerable new producing area was added by extensions of the Long Beach and Midway fields. A small amount of oil was discovered at Seal Beach, Los Angeles County; in Sonoma County, near Petaluma; and in Monterey County, southwest of Salinas. New and deeper producing horizons were discovered in the Brea-Olinda, Sunset, and Cat Canyon fields."

Outlook for 1926.

Figures for the first six months of 1926 indicate a slight decline in yield for the current year compared with 1925. Production has dropped to around 610,000 barrels per day from the 1925 average of 634,000 barrels daily. Effective March 11th, prices were advanced for the lighter grades of crude oil.

Production Figures.

The following table gives the production and value by counties for 1925, compared with the 1924 figures:

Production and Value of Crude Oil, by Counties.

	1924		1925	
County	Barrels	Value	Barrels	Value
Fresno	10,156,405	$11,801,743	7,773,665	$8,503,390
Kern	61,175,405	69,572,934	58,852,742	84,255,094
Los Angeles	119,027,428	147,474,953	121,214,551	173,215,593
Orange	31,661,283	37,455,298	32,734,420	46,384,673
San Luis Obispo	31,222	30,972	29,590	32,164
Santa Barbara	2,905,181	3,009,768	2,647,380	2,419,705
Santa Clara	14,417	20,481	13,828	22,594
Ventura	3,958,010	5,279,985	9,221,846	15,769,357
San Bernardino and San Mateo	[a] 4,120	6,740	[b] 4,125	7,259
	228,933,471	$274,652,874	232,492,147	$330,609,829

[a] Combined to conceal output of a single operator in each.
[b] Combined to conceal output of a single operator in San Bernardino County.

The foregoing totals show a state average price of $1.422 per barrel for the year 1925, as compared to $1.200 in 1924 and $0.923 in 1923.

Oil in 'Storage.'

Field, refinery, pipe-line, and tank-farm stocks of crude and refinery products in Pacific Coast territory totaled 153,795,682 barrels,[1] December 31, 1925, compared with 125,021,964 barrels on December 31, 1924, distributed as follows:

Stocks	Dec. 31, 1925 (Barrels)	Dec. 31, 1924 (Barrels)
Heavy Crude, heavier than 20° A.P.I., including all grades of fuel	82,849,057	57,254,796
Refinable Crude, 20° A.P.I., and lighter	44,345,837	40,574,578
Gasoline	10,172,562	10,957,487
Naphtha Distillates	6,548,483	9,396,613
All other stocks	9,879,743	6,838,490
Totals, all stocks	153,795,682	125,021,964

Proved Oil Land.

The total proved oil land of the state increased to 121,436 acres, as against 118,979 acres in 1924. Of this 1925 total, 22,673 acres being owned by Federal, State, and City governments, or for other reasons, is not assessable for the support of the Department of Petroleum and Gas of the State Mining Bureau. The acreage in 1925 was distributed by counties as follows:

---

[1] Standard Oil Bulletin, February, 1926, p. 13.

Proved Oil Land and Number of Wells, 1925.

County	Land (Acres)	Number wells
Fresno	14,636	969
Kern	76,398	5,931
Los Angeles*	11,239	2,807
Orange	6,630	979
San Bernardino	----	1
San Luis Obispo	402	11
San Mateo	----	3
Santa Barbara	7.823	354
Santa Clara	80	9
Ventura	4,228	571
Totals	121.436	11.635

* Not including the old Los Angeles City Field.

SALT.

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean. plants being located on the shores of San Francisco. Monterey, and San Diego bays. and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions. mainly in Kern and San Bernardino counties. A small amount of valuable medicinal salts is obtained by evaporation of the water of Mono Lake, Mono County.

Distribution of the 1925 salt production of California. by counties, was as follows:

Salt Production, by Counties, 1925.

County	Tons	Value
Alameda	180,712	$497.692
Kern	6.890	28.858
San Bernardino	28.319	101,085
San Mateo	31.325	155.925
Los Angeles, Modoc, Mono,[a] Monterey, San Diego[b]	36.822	166.266
Totals	284.068	$949.826

[a] Medicinal salts.
[b] Combined to conceal output of a single operator in each.

The above returns show a decrease both in tonnage and value from the record figures of 1924 which were 318.800 tons and $1,159.137. Slightly lower market prices prevailed during 1925. as a result of price cutting by one or two of the operators. As in 1924. there were nine plants operating in Alameda County in 1925. but a total of only eleven in the other counties tabulated (a decrease of one).

SILVER.

Except for the early-day production from the silver mines of the Calico district and the more recent production from those of the Randsburg area. both of which are in San Bernardino County, the recovery of silver in California has been largely as a by-product from its association with copper. lead. zinc. and gold ores.

The 1925 silver output of California totaled 3.054.416 fine ounces. valued at $2.106.871. compared with 3.555.153 fine ounces valued at $2,381.952 in 1924. Of the 1925 yield, $12.894 was from placers. The average price of domestic silver during 1925 was 69.4¢ per ounce in New York, as against 67c in 1924. and $1.00 in 1921-1923 under the Pittman Act. The figures below are those of the U. S. Bureau of Mines, Department of Commerce (as explained under Gold).

The distribution of the 1925 silver yield, by counties, was as follows:

Silver Production, by Counties, 1925.

County	Fine ounces	Value
Alpine	2	$1
Amador	23,232	16,123
Butte	6,274	4,354
Calaveras	11,994	8,324
Del Norte	2	1
El Dorado	343	238
Fresno	217	151
Humboldt	90	62
Inyo	169,688	117,763
Kern	10,742	7,455
Lassen	34	24
Los Angeles	22,254	15,444
Madera	118	82
Mariposa	2,533	1,758
Merced	2	1
Mono	2,291	1,590
Monterey	4	3
Napa	2,046	1,420
Nevada	46,333	32,155
Orange	1,433	995
Placer	893	620
Plumas	423,997	294,254
Riverside	3,703	2,570
Sacramento	2,767	1,920
San Bernardino	1,986,155	1,378,392
San Diego	83	58
San Luis Obispo	10	7
Shasta	300,890	208,818
Sierra	12,852	8,919
Siskiyou	1,198	831
Stanislaus	1 000	694
Trinity	11,129	7,724
Tuolumne	885	614
Yuba	9,222	6,400
Totals	3,054,416	$2,119,765

SOAPSTONE AND TALC.

The total output of talc and soapstone in California in 1925 amounted to 15,465 tons valued at $239,084, compared with 16,179 tons valued at $242,770 in 1924. Nearly 80% of the product was high-grade talc from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper, and rubber manufacture, and some in ceramics. The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

It is reported that Californian talc is steadily replacing imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of massive soapstone from Virginia. Foreign importations of high-grade white talc suitable for manufacture of toilet powder have come mainly from Canada, Italy, and France. Foreign producers have the benefit of cheap labor, and a low tariff import duty.

SODA.

The production of carbonates and sulphate of sodium in California in 1925 included: soda ash and bicarbonate from plants at Owens Lake, Inyo County; trona ('sesqui-carbonate,' a double salt of Na_2CO_3 and $NaHCO_3$) from Searles Lake, San Bernardino County; and salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County. The total amounted to 48,625 tons valued at $947,649, being an increase in both quantity and value compared with the 1924 figures of 32,536 tons and $711,796.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, and chemicals; the salt cake in paper making; and the trona for metallurgical purposes.

TUNGSTEN.

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920-1922 (inclusive), when the mines were shut down owing to low prices due to excess stocks following the war and to lack of tariff protection against foreign importations. Production was resumed on a small scale late in 1923, and has now practically regained its pre-war average annual tonnage, though the 1925 figures are about 25% less than those for 1924.

The material shipped in 1925 included both high-grade sorted ore and concentrates, coming from properties in Inyo and San Bernardino counties. A total of 8619 tons of all grades was reported produced, and in part concentrated, yielding 573 tons recalculated to 60% WO_3, valued at a total of $348,471.

Prices during 1925 ranged rather regularly from $9.00 per unit, duty paid, for Chinese wolframite in January, to $12.00 in December; with domestic scheelite commanding 50¢ to $1.00 per unit higher. Present (July, 1926) prices are $11.75 to $12.75, with domestic demand light, though curtailment of Chinese supplies is anticipated.

ZINC.

Recoverable zinc in ores mined in California in 1925 amounted to 11,546,602 pounds valued at $877,542, compared with 3,060,000 pounds and $198,900 in 1924. The 1924 output was marketed entirely in the form of the oxide; but the major portion of the 1925 yield (in the form of concentrates) was shipped to Belgium for treatment. A small amount of oxide was marketed.

The average price per pound quoted for the metal in 1925 was 7.6¢ as against 6.5¢ in 1924.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

Frank Sanborn, Mineral Technologist.

Sericite mica-schist samples from Inyo and other counties in the state are frequently received at this laboratory for identification. It has been stated that these schists, which resemble talc in feel and general appearance, occur in large deposits. The fact that sericite mica contains alumina up to 38%, and potash up to 11% suggests the possibility of these schists being a potential source of potash with a residue suitable for use in the cement or ceramic industries.

As far back as 1857 a patent was taken out for extracting potash from feldspar, lava, etc., by mixing them with fluorite or calcium carbonate and heating to bright redness; the alkali being subsequently extracted from the mass by leaching with boiling water.

A number of methods of extracting potash from feldspar have been tried with partial success, but apparently unless the residue can also be utilized commercially, the costs of extracting the potash are too high for a profitable recovery of potash alone. In the case of sericite mica-schist the mining and treatment costs would probably be much less than they would be for feldspar, and a residue obtained that could be utilized in ceramics or cement making.

A total of 1293 samples were received during the four-month period covered by this report. Requests for the identifications come from practically every county in the state.

◆

LIBRARY.

FOREST L. CAMPBELL, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

- Bulletin 768—Geology and Oil Resources of the Puente Hills Region, Southern California. By W. A. English.
- Bulletin 776—The Mesozoic Stratigraphy of Alaska. By George C. Martin.
- Bulletin 779—Guides to Ore in the Leadville District, Colorado. By G. F. Loughlin.
- Bulletin 783-A—Mineral Industry of Alaska in 1924 and Administrative Report. By P. S. Smith.
- Bulletin 783-B—Mineral Investigations in Southeastern Alaska. By A. F. Buddington.
- Bulletin 783-D—The Nixon Fork Country and Silver-Lead Prospects near Ruby. By J. S. Brown.
- Bulletin 785-B—Potash Investigations in 1924. By W. B. Lang.
- Professional Paper 139—Geology and Ore Deposits of the Ducktown Mining District, Tennessee. By W. H. Emmons.
- Professional Paper 140—Shorter Contributions to General Geology 1925. By W. C. Mendenhall.
- Professional Paper 143—Paleontology and Stratigraphy of the Castle Hayne and Trent Marls in North Carolina. By L. B. Kellum.
- Professional Paper 145—Geology and Oil and Coal Resources of the Oregon Basin and Grass Creek Basin Quadrangles, Wyoming. By D. F. Hewett.
- Water Supply Paper 558—Preliminary Index to River Surveys made by the United States Geological Survey and Other Agencies. By B. E. Jones.
- Water Supply Paper 562—South Atlantic Slope and Eastern Gulf of Mexico Basins. By Nathan C. Grover.

U. S. Bureau of Mines:

Bulletin 252—Beneficiation and Utilization of Georgia clays. By R. T. Stull.

Mineral Resources of the United States:

Natural Gas in 1924.

Gold, Silver, Copper, and Lead in Arizona in 1924.

Barytes and Barium Products in 1924.

Natural-Gas Gasoline in 1924.

Stone in 1924.

Fuel Briquetts in 1925.

Technical Paper 363—Analysis of Virginia Coals. By J. B. Eby.

Technical Paper 365—Lessons from the fire in the Argonaut Mine. By B. O. Pickard.

Technical Paper 356—Analyses of Tennessee Coals. By Wilbur A. Nelson.

Technical Paper 377—Red Iron Ores and Ferruginous Sandstones of the Clinton Formation in the Birmingham District, Alabama. By W. R. Crane.

Technical Paper 382—Accidents in the California Petroleum Industry in 1923.

Technical Paper 395—Accidents at the Metallurgical Works in the United States during the Calendar Year 1925. By W. W. Adams.

Reports of Investigations:

Serial No. 2743—Coal Mining Royalties and Leasing Conditions in Vermilion and Edgar Counties, Illinois (District VIII). By L. D. Tracy.

Serial No. 2744—Flotation of Limestone from Siliceous Gangue. By Oscar Lee.

Serial No. 2745—Tests and Characteristics of Dust Respirators. By S. H. Katz, G. W. Smith, and E. G. Meiter.

Serial No. 2746—Sanitary Survey of the Coal Mines of Alabama. By F. V. Meriwether.

Serial No. 2747—Study of the Reactions in an Iron Blast Furnace. By S. P. Kinney, P. H. Royster, and T. L. Joseph.

Serial No. 2748—Consumption of Explosives in March, 1926. By W. W. Adams.

Serial No. 2749—Coal-Mine Fatalities in March, 1926. By W. W. Adams.

Serial No. 2750—Gas Mask for Protection Against Ammonia Gas. By A. C. Fieldner, S. H. Katz, and H. W. Frevert.

Serial No. 2751—Nomographic Charts for Computing the Rate of Leakage from Natural Gas Lines. By E. O. Bennett.

Serial No. 2752—Methods of Testing High-Pressure Natural-Gas Lines for Leakage Losses. By E. L. Rawlins.

Serial No. 2753—Consumption of Explosives in April, 1926. By W. W. Adams.

Serial No. 2754—Coal-Mine Fatalities in April, 1926. By W. W. Adams.

Serial No. 2755—The Sizing Action of a Coal-Washing Table. By Byron M. Bird.

Serial No. 2756—Subject List of Reports of Investigations Issued During 1925.

Serial No. 2757—Extinction of Methane Flames by Helium. By H. F. Coward and G. W. Jones.

Serial No. 2758—Explosibility of Oil-Shale Dust. By Vernon C. Allison and Arthur D. Bauer.

Serial No. 2759—Consumption of Explosives in May, 1926. By W. W. Adams.

Serial No. 2760—Coal-Mine Fatalities in May, 1926. By W. W. Adams.

Serial No. 2761—Magnetic Concentration of Flue Dust of the Birmingham District. By Oscar Lee, B. W. Gandrud, and F. D. DeVaney.

Serial No. 2762—Manufacture of Lime from Small Stone with a Sintering Machine. By W. M. Myers.

Serial No. 2763—Coal-Mine Fatalities in June, 1926. By W. W. Adams.

Serial No. 2764—Consumption of Explosives in June, 1926. By W. W. Adams.

Information Circulars:

Circular No. 6004—Record of the Pittsburgh Testing Station Standard Dynamite. By S. P. Howell.

Circular No. 6006—Manufacture and Characteristics of Gasoline. By A. J. Kraemer.

Circular No. 6007—The Quicksilver Situation from a Domestic Standpoint. By J. W. Furness and R. M. Santmyers.

Circular No. 6008—Rock Dust Material for Coal Mines.
Circular No. 6009—Gases Commonly Used in the Industries and the Home and Their Hazards. By A. C. Fieldner.
Circular No. 6010—Leakage Losses from Pipe Lines Carrying Natural Gas Under High Pressures. By E. L. Rawlins.
Circular No. 6011—The Movement of Oil Through the Panama Canal. By G. R. Hopkins.
Connecticut Geological and Natural History Survey: Bulletin 33—The Geology of the Stonington Region, Connecticut. By L. H. Martin.
Idaho Inspector of Mines: Twenty-seventh Annual Report of the Mining Industry in Idaho for the year 1925.
Bureau of Mines and Geology:
Pamphlet 15—Ground Water for Irrigation on Camas Prairie, Camas and Elmore Counties, Idaho. By A. M. Piper.
Pamphlet No. 16—Ground Water for Municipal Supply at Idaho Falls, Idaho. By A. M. Piper.
Illinois State Geological Survey:
Bulletin 47—Geology and Mineral Resources of the Equality Shawneetown Area. By Chas. Butts.
Bulletin 50—Natural Bonded Molding Sand Resources of Illinois. By M. S. Littlefield.
Bulletin 52—Pennsylvania Flora of Northern Illinois. By A. C. Noe.
Bulletin 48—Geology and Mineral Resources of the Carbondale Quadrangle. By J. E. Lamar.
Bulletin 51—Geology and Mineral Resources of the Joliet Quadrangle.
Reports of Investigations:
No. 8—Preliminary Report on the Economic Mineral Resources of Calhoun County. By J. E. Lamar.
No. 9—The Glenwood Beds as a Horizon Marker at the Base of the Platteville Formation. By Arthur Bevan.
Indiana Department of Conservation: Seventh Annual Report for the year ending September 30, 1925.
Kaolin of Indiana. By W. N. Logan.
Division of Geology: No. 55—Geology of the Deep Wells of Indiana. By W. N. Logan.
Kentucky Geological Survey:
The Clays of Kentucky. By W. R. Jillson.
Pamphlet No. 8—Fire Clays of Northeastern Kentucky. By W. R. Jillson.
Michigan Geological Survey Division: Pub. 36—Clays and Shales of Michigan. By G. G. Brown.
Minnesota Geological Survey: Bulletin 21—The Geology and Magnetite Deposits of Northern St. Louis County. By Frank F. Grout.
Mississippi State Geological Survey: Bulletin 20—Geology and Mineral Resources of Mississippi. By E. N. Lowe.
Ohio Topographic Survey: Final Report on Land Subdivision, Vol. 3, 1925.
Oklahoma Geological Survey:
Bulletin 31—Criteria for the Recognition of Heavy Minerals Occurring in the Mid-Continent Field. By F. C. Edson.
Bulletin 36—Petroleum Engineering in the Papoose Oil Field. By John R. Dunn.
Bulletin 37—Geology of Texas County, Oklahoma. By Chas. N. Gould.
Pennsylvania Topographic and Geologic Survey:
Bulletin M6—Bituminous Coal Fields of Pennsylvania. By J. D. Sisler.
Bulletin M7—Limestone of Pennsylvania. By B. L. Miller.
Tennessee Division of Geology: Bulletin 33-B—The Northern Tennessee Coal Field. By L. C. Glenn.
Washington Department of Conservation and Development: Report of Investigation No. 1—Abstract of the Report on the Geology and Resources of the Pasco and Prosser Quadrangles. By H. E. Culver.
Wisconsin Geological and Natural History Survey: Bulletin 56-A—Soil Survey of Milwaukee County, Wisconsin. By A. R. Whitson, et al.
California Highway Commission: Important Statutes Relating to the California Highway Commission, compiled Nov., 1925.
California Industrial Accident Commission: Report of the Industrial Accident Commission of the State of California from July 1, 1924, to June 30, 1925.

Argentina Ministerio de Agricultura:
- Pub. 12—Informe sobre un Yacimiento de Mineral de Hierro en la Sierra de Paganzo. By Roberto Beder.
- Pub. 13—Las Termas de Rosario de la Frontera. By Juan Rassmuss.
- Pub. 14—Contribucion al Estudio de las Fuentes Termo—Minerales de Rosario de la Frontera. By Hercules Corti.
- Pub. 15—La Laguna de Epecuen. By Hercules Corti.
- Pub. 16—Las Concretiones de Mineral de Manganeso de Puerta Quemada, Dpto. de Burruyacu. By Roberto Beder.

Canada Department of Mines:
- Memoir 144—Mount Albert Map-area, Quebec. By F. J. Alcock.
- Economic Geology Series No. 1—Geology and Economic Minerals of Canada. By G. A. Young.
- Summary Report, 1924, Part B.
- Report of the Department of Mines for the Fiscal Year Ending March 31, 1925.
- Bulletin 55—Preliminary Report on the Mineral Production of Ontario in 1925.
- Memoir 143—North Shore of Lake Huron. By W. H. Collins.
- Museum Bulletin No. 40—Birds Collected and Observed During the Cruise of the Thiepval in the North Pacific, 1924. By H. M. Laing.

Ontario Department of Mines: 33rd Annual Report, 1924, Parts I to VII.
- Final Report of the Peat Committee appointed jointly by the Governments of the Dominion of Canada and the province of Ontario. By B. F. Haanel.

Great Britain Geological Survey:
- Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the year 1925.
- The Geology of the Carlisle, Longtown and Silloth District. By E. E. L. Dixon, et al.
- Central Coalfield of Scotland.

New Zealand Bureau of Mines: Bulletin 27—The Geology of the Whangarei-Bay of Islands Subdivision, Kaipara Division. By H. T. Ferrar.

Russia Institute of Economic Mineralogy and Metallurgy:
- No. 19—The Jourawlinskee Bauxit-Deposit.
- No. 20—The Jourawlinskee Bauxit-Deposit.
- No. 21—The Metallogenous Epochs and Regions of Siberia.
- No. 24—Cordierite Granulites and Kelyphytic Structure.
- No. 28—Essays of Economical Costs Calculation for our Aluminum Home Works Plant and Aluminum's Production Cost.

South Australia Department of Mines: Mining Review for the half year ended December 31, 1925.

Victoria Geological Survey, Australia:
- Memoir 15—The Aberfeldy District, Gippsland. By W. Baragwanath.
- Records of the Geological Survey of Victoria, Vol. 4, No. 4.
- Bulletin 44—Bright, Wandiligong and Freeburgh Goldfields. By J. P. L. Kenny.

Transvaal Chamber of Mines:
- 36th Annual Report for the year 1925.
- Reports of the Executive, Gold Producers and Colleries Committees for the year 1925.

Geological Institute of South Manchuria R. R. Co.: Explanatory Text to the Geological Map of Manchuria.

Societies and Educational Institutions.

California, University of:
- Bulletin of the Department of Geological Sciences, Vol. 16, No. 4—Cassididae of Western America. By H. G. Schenck.
- Publications in Engineering:
  - Vol. 2, No. 8—Theory of Aeroplane Structural Members Subjected to Combined Axial and Non-Uniform Transverse Loads. By J. E. Younger.
  - Vol. 2, No. 7—An Investigation of the Influence of Pitch on the Performance of an Air Propeller when its Slipstream is Obstructed. By B. M. Woods.
- Bulletin of the Department of Geological Sciences, Vol. 16, No. 3—Anchitheriine Horses from the Fish Lake Valley Region, Nevada. By Chester Stock.

McGill University, Montreal: Announcement of the Faculty of Applied Science for the Season 1926-27.
Oklahoma, University of: Bulletin of the College of Engineering for 1926.
Oregon, University of: Mount Multnomah, Ancient Ancestor of the Three Sisters. By E. T. Hodge.
Real Academia de Ciencias y Artes de Barcelona: Num. 12—Monographia de los Tipulados de las Islas Canarias. By Dr. E. S. Abreu.
Tokyo, Imperial University of:
  The Mineralization in the Susaki Mine in the Province of Idzer. By T. Kato.
  Journal of the Faculty of Science, Vol. 1, Parts 2, 5, and 6.
Musau Nacional de Rio de Janeiro—Archivos, Vol. XXV.
Library of Congress: Report of the Librarian of Congress for the Fiscal Year Ending June 30, 1925.
California Academy of Sciences:
  Proceedings:
    Vol. II, Part II, No. 18.
    Vol. IV, Nos. 18, 19, 20.
    Vol. XII.
    Vol. XIII.
    Vol. XV, Nos. 1 to 11.
Field Museum of Natural History: Publication 235—Annual Report of the Director to the Board of Trustees for the year 1925.
Philadelphia, Academy of Natural Sciences of: Yearbook for the year ending December 31, 1925.

Books.

Potash. By J. W. Turrentine.
Handbook of Non-Ferrous Metallurgy. 2 Vols. By Liddell.
Stainless Iron and Steel. By Monypenny.

Maps.

Topographic Maps:
  Bell, Cal.
  Cave-in-Rock, Ky.-Ill.
  Centerpoint, W. Va.
  Clearwater, Cal.
  East Columbus, Ohio.
  Edgeley, N. Dak.
  Gravelly Springs, Ala.
  Havana, Ill.
  Jay Peak, Vt.
  Alhambra, Cal.
  Bluefield, West Va.-Va.
  Bradford, Pa.-N. Y.
  Burnham, Maine.
  Deposit, N. Y.
  Fairmont, W. Va.
  Gays Mills, Wis.
  Dry Canyon, Cal.
  Zelzah, Cal.
  Sylmar, Cal.
  Lahaina, T. H.
  Martinsville, Va.-N. C.
  Mingo, W. Va.
  San Joaquin, Cal.
  Towanda, Pa.-N. Y.
  Waldo Lake, Ore.
  Washtucna, Wash.
  Wheeler, Wash.
  Yorkville, Ill.
  Great Smoky Mountains National Park, N. C.-Tenn.
  Hollywood, Cal.
  La Farge, Wis.
  Laurel, Md.
  Mannington, W. Va.
  Shenandoah National Park, Va.
  Viroqua, Wis.
  Elk Hills Naval Reserve No. 1, Cal.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Bulletin, Union Oil Co., Los Angeles.
California Journal of Development, San Francisco.
Cement, Mill and Quarry, Chicago, Illinois.

Chemical-Engineering and Mining Review, Melbourne, Australia.
Engineering and Mining Journal-Press, New York.
Explosives Engineer, Wilmington, Del.
Financial Insurance News, Los Angeles, California.
Graphite, Jersey City.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mine and Quarry, Chicago.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil and Gas News, Kansas City.
Oil News, Galesburg, Illinois.
Oildom, New York.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, San Francisco, Cal.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.

Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of Mining in California was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of Mining in California, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

41–11 Mining or Metallurgy. Three years' experience as surveyor, engineer, and chemist. Age 27. Single. References. Salary open.

41–12 Shift boss, foreman or assayer. Twenty-five years' experience in mines and mills of Nevada, Arizona, and California. Age 50. Married. References. Salary open.

41–13 Chemist's Assistant. Four years' study I.C.S. in analytical chemistry. Age 45. Married. References. Salary open.

41–14 Technical position in oil or gas production. Five years' experience. Age 29. Single. References. Salary wanted $175.

41–15 Industrial engineer; millwright. Ten years' experience as civil engineer, industrial engineer and superintendent of constructon. Age 40. Marred. References. Salary wanted $4800.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper	----
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915—1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz counties	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial counties	.25
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1925	Free
January, February, March, April, May, June, 1926	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston. 85 pp., 46 illustrations	$0.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899. 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900. 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901. 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps	.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903. 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903. 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904. 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905. 168 pp., 54 illustrations	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905. 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907. 54 pp	$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp	----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	$0.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted	2.50
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring. 1918. 248 pp., 51 illustrations, 5 maps, paper	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley, 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth	1.00
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916–1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917–1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	----
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth	1.00

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	$1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley, 1923, 188 pp., paper	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley, 1924, 162 pp., paper	Free
Bulletin No. 95. Geology and Ore Deposits of the Randsburg Quadrangle, by Carlton D. Hulin, 1925. 152 pp., 49 photographs, 13 line cuts, 1 colored geologic map, cloth	2.00
Bulletin No. 96. California Mineral Production for 1924, by Walter W. Bradley, 1925. 173 pp., paper	Free

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.	Price
**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	Free
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

	Price
**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County	$0.25
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County	.25
Register of Oil Wells, with Map, Los Angeles City	.35

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California. Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted	.50
**Unmounted	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	----
**Map of Trinity County	----
**Map of Tuolumne County	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

	Price
Map No. 1—Sargent, Santa Clara County	$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emido and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	1.00
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

47285 10-26 2650

THE STATE MINING BUREAU

CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE

MINERAL RESOURCES OF CALIFORNIA

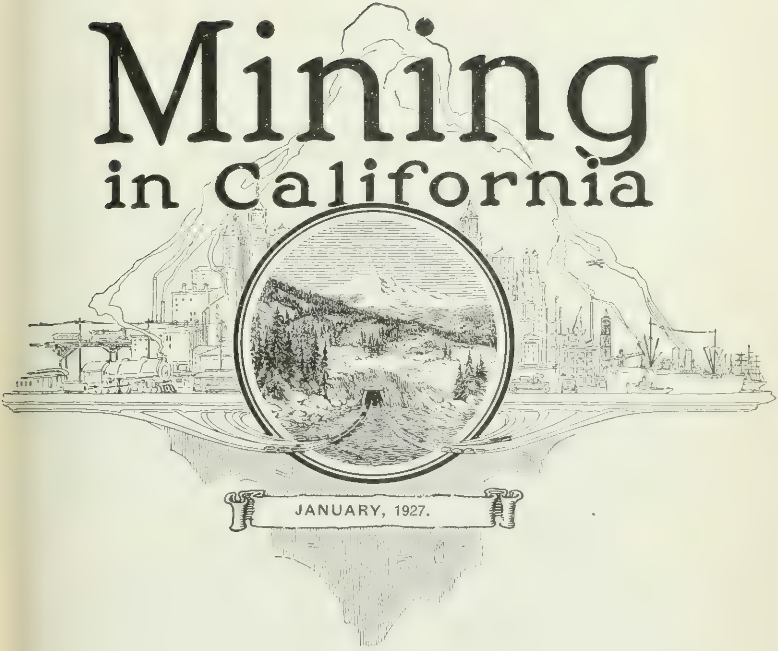
At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the state mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily
Saturday, 9 a.m. to 12 m.

Lloyd L. Root,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.
Branch Offices: New Orpheum Building, Los Angeles; Chamber of Commerce Building (mail address, P. O. Box 1208), Sacramento; Bank of Italy Building, Bakersfield; Taft, Coalinga, Santa Maria, and Santa Paula.

Mining
in California



JANUARY, 1927.

PUBLISHED QUARTERLY

CALIFORNIA STATE
MINING BUREAU
FERRY BUILDING
SAN FRANCISCO

50727

CALIFORNIA STATE MINING BUREAU

EXECUTIVE AND TECHNICAL STAFF

LLOYD L. ROOT
State Mineralogist

WALTER W. BRADLEY
Deputy State Mineralogist

MINING DIVISION

C. A. Logan, District Mining Engineer	Sacramento
C. McK. Laizure, District Mining Engineer	San Francisco
W. Burling Tucker, District Mining Engineer	Los Angeles
Frank Sanborn, Mineral Technologist	San Francisco
W. F. Dietrich, Ceramic Engineer	San Francisco

DEPARTMENT OF PETROLEUM AND GAS

R. D. Bush, State Oil and Gas Supervisor	San Francisco

Note.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT State Mineralogist

Vol. 23 JANUARY, 1927 No. 1

CHAPTER OF

REPORT XXIII OF THE STATE MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU

CALIFORNIA STATE PRINTING OFFICE
CHARLES A. WHITMORE, State Printer
SACRAMENTO, 1927

CONTENTS.

Page

DISTRICT REPORTS OF MINING ENGINEERS 1

- Sacramento Field Division 1
- San Francisco Field Division 2
- Contra Costa County 2
- Los Angeles Field Division 32
- Santa Catalina Island 32
- Oil Field Development Operations 40

SPECIAL ARTICLES 44

- Report of Hydraulic Mining Commission 44

ADMINISTRATIVE DIVISION 117

DIVISION OF MINERALS AND STATISTICS 118

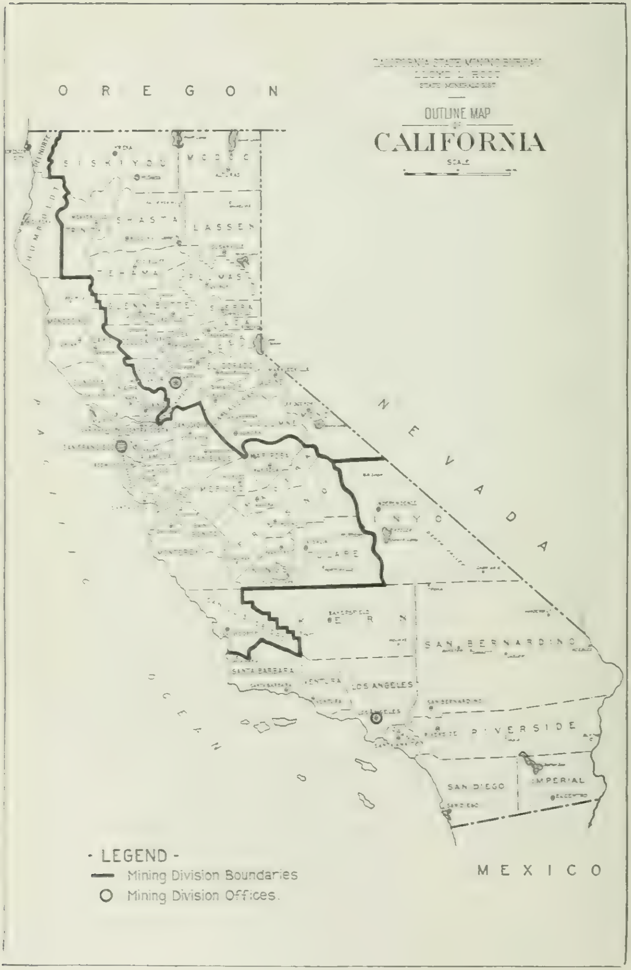
- Statistics 118
- Museum 119
- Laboratory 119

LIBRARY 121

PRODUCERS AND CONSUMERS 129

EMPLOYMENT SERVICE 130

BUREAU PUBLICATIONS I


CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
NEVADA
PACIFIC OCEAN
MEXICO
DEL NORTE
SISKIYOU
MODOC
HUMBOLDT
SHASTA
TRINITY
LASSEN
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
MENDOCINO
LAKE
COLUSA
EL DORADO
NAPA
SONOMA
ALPINE
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
SAN FRANCISCO
MONO
STANISLAUS
MARIPOSA
MERCED
FRESNO
INYO
SAN BENITO
MONTEREY
TULARE
DEATH VALLEY
KERN
SAN LUIS OBISPO
BAKERSFIELD
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
RIVERSIDE
SAN DIEGO
IMPERIAL
- LEGEND -
Mining Division Boundaries
○ Mining Division Offices.

PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of $1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919–1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available, for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

On account of unfinished field work, there is no report from the Sacramento Field Division in this issue.

SAN FRANCISCO FIELD DIVISION.

C. McK. Laizure, Mining Engineer.

CONTRA COSTA COUNTY.

Introduction:

When Contra Costa County was originally created in 1850 it included besides its present area about two-thirds of what is now Alameda County.[1] It extended as far south as Alameda Creek, and Santa Clara County adjoined it on the south. The southern third of Contra Costa County and a portion of Santa Clara County were together organized as Alameda County in 1853. Since then its boundaries, except for slight changes in definition, have remained as they are today.

Geography and Topography.

Contra Costa is one of the East Bay counties, bounded on the west and north by the waters of San Francisco, San Pablo and Suisun Bays and San Joaquin River. At the junction of the Mokelumne River with the San Joaquin, the county line turns in a southerly direction and follows the Old River channel nearly due south to Cooney Island, separating Contra Costa from San Joaquin County on the east. From Cooney Island the southern boundary, separating it from Alameda County, runs a little south of west in a straight line to the summit of Divide Ridge just north of Dublin Canyon, thence northwesterly along the summit of the Berkeley Hills to El Cerrito and down El Cerrito Creek to the Bay.

The county has an area of 714 square miles, about half of which is under cultivation. Its population is 53,889 (1920 census). Industry, agriculture, stock raising, and to a lesser extent mining contributes to the prosperity of this area. The county is traversed by both the Southern Pacific and the Santa Fe railroads, which closely follow the water front throughout its length. A branch of the Southern Pacific passes through the central (San Ramon) valley section, connecting Avon on the coast with Livermore, Alameda County, via Walnut Creek and Danville. The electric line of the Oakland, Antioch and Eastern Railroad also traverses the county in a northeasterly direction.

Its industrial and shipping activities are extensive. The county has approximately 70 miles of deep water front on which are located nine port cities: Richmond, Selby, Crockett, Port Costa, Martinez, Avon, Bay Point, Pittsburg, and Antioch. Richmond is the largest city and Martinez the county seat. Among the more important manufacturing plants, chemical and industrial works, allied with the mining industry and in many cases buyers and users of raw mineral products are the following:

At Antioch:

Paraffine Companies, Inc.

At Avon:

Associated Oil Co. (refinery).

---

[1] Coy, Owen C., California County Boundaries, California Historical Survey Commission. Berkeley, 1923.

At Bay Point:
Pacific Alloy and Steel Co.

At Crockett:
California and Hawaiian sugar refinery.

At Giant:
Giant Powder Co.

At Hercules:
Hercules Powder Co.

At Martinez:
Mountain Copper Company (smelter, sulphuric acid and fertilizer plant).
Shell Oil Co. (refinery).

At Oleum:
Union Oil Co. (refinery).

At Pittsburg:
National Chemical Co. of Cal.
Great Western Electro-Chemical Co.
General Chemical Co.
Pioneer Rubber Mills.
Columbia Steel Corporation.
Johns-Manville Co.

At Richmond:
Santa Fe Foundry Co.
Stauffer Chemical Co.
Wheeler-Reynolds Chemical Co.
Certain-teed Products Corp.
Pacific Sanitary Manufacturing Co.
Standard Oil Co. (refinery).

At Selby:
American Smelting and Refining Co. (smelter).

At Stege:
Union Superphosphate Co.

Topographically, Contra Costa County is distinguished by containing the most prominent land mark in the central coast counties, Mt. Diablo, which rises to an elevation of 3849 feet above sea level. This peak is in the eastern of the two main ridges of the Coast Range Mountains, which strike northwesterly across the county. The western ridge lies close to the coast. Its crest is more regular but its highest peaks are less than 2000 feet in elevation. The western flank slopes gently toward San Francisco Bay. Between the eastern and western ridges lies San Ramon valley, drained by San Ramon Creek, which flows northward into Walnut Creek and hence into Suisun Bay. Marsh Creek rises on the eastern slope of Mt. Diablo and flows northeasterly into the San Joaquin River. These are the two principal streams in the county. The northeastern corner of the county is included in the delta area of San Joaquin valley and is elevated only slightly above sea level.

CONTRA COSTA

Year	Brick		Coal*		Lime	
	M.	Value	Tons	Value	Barrels	Value
1894			35,000	$94,000		
1895			48,635	139,655		
1896	150	$4,500	44,892	118,709		
1897			39,267	105,180		
1898	5,000	25,000	47,000	113,340		
1899			53,013	131,613		
1900			51,248	145,000		
1901			35,000	100,000		
1902	800	11,600	13,960	31,160		
1903	2,600	16,000			5,300	$4,500
1904	9,385	67,495			12,187	10,359
1905	10,979	73,948			20,244	13,925
1906	23,267	169,022				
1907	48,573	403,564			1,413	1,413
1908	55,844	335,737				
1909	41,033	268,122			14,062	15,468
1910	30,284	199,079			17,338	14,750
1911	36,463	271,575			11,872	8,645
1912	32,621	283,718			14,870	12,640
1913	30,411	212,953			150,551	127,968
1914	16,064	129,543	67	268	5,666	4,724
1915	14,915	139,862	[2]			
1916	16,672	148,730	[2]			
1917	and tile	172,653	[2]			
1918	and tile	148,831				
1919		[2]				
1920	13,608	312,398				
1921		[2]				
1922	and tile	307,749				
1923		[2]				
1924	and tile	327,225				
1925		[2]				
Totals		$4,029,304	[3]368,082	$978,925	253,503	$214,392

[1] Includes crushed rock, rubble, rip-rap, sand, gravel.

[2] See under 'Unapportioned.'

[3] Estimated.

*Coal mining began in the Mount Diablo section of Contra Costa County at least as early as 1861, but there are no segregated county figures available earlier than those here shown. For 1867-1882 (inc.), there are records which indicate for the Mount Diablo field a total of approximately 2,500,000 tons, valued at $14,300,000.

COUNTY, 1894-1925.

Limestone		Mineral water		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Tons	Value	Gallons	Value		Amount	Value	Substance
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	7,600	$3,700	$9,000	1,400 tons	$2,200	Pottery clay.
--------	--------	5.000	1,200	--------	--------	--------	
--------	--------	9,300	3,100	--------	--------	--------	
--------	--------	10,000	3,500	--------	--------	--------	
--------	--------	12,000	1,900	--------	--------	--------	
--------	--------	12,000	1,900	--------	--------	--------	
--------	--------	31,200	8,736	--------	31,700 lbs.	3,645	Copper.
18,000	$22,500	78,000	19,500	--------	--------	--------	
--------	--------	78,000	19,000	23,060	--------	--------	
34,800	43,500	[2]	--------	76,120	--------	--------	
--------	--------	--------	--------	75,025	--------	--------	
22,038	43,038	--------	--------	210,250	2,057 tons	21,870	Asphalt.
9,140	18,282	109,400	5,470	236,047	9,500 tons 6,000 tons	123,500 7,500	Asphalt. Pottery clay.
22,556	42,837	199,800	10,590	233,782	17,085 tons --------	222,105 683,392	Asphalt. Unapportioned products.
22,912	37,064	2,500	375	235,655	--------	--------	
68,708	46,208	206,500	10,325	257,503	--------	--------	
25,879	45,291	200,000	10.000	478,162	--------	--------	
26,259	34,976	192,292	4,989	660,405	--------	921,349	Other minerals.
32,657	43,661	364,288	3,643	308,727	--------	658,755	Other minerals.
11,989	14,565	[3]350,000	4,000	397,330	--------	757,748	Asbestos, mineral water.
[2]	--------	351,724	6,154	363,753	--------	700,424	Cement, clay, and limestone.
--------	--------	436,265	8,563	322,507	--------	772,944	Cement and clay.
--------	--------	30,376	3,038	324,884	100 tons --------	500 847,198	Pottery clay. Cement and copper.
--------	--------	[2]	--------	275,309	--------	193,340 926,909	Clay and clay products. Cement and mineral water.
--------	--------	--------	--------	432,654	1,743 tons --------	3,319 1,333,682	Pottery clay. Cement and mineral water.
--------	--------	600,300	6,099	415,127	-------- --------	198,248 1,003,258	Clay and clay products. Other minerals.
--------	--------	--------	--------	559,915	7,086 tons --------	12,910 1,516,738	Pottery clay. Cement, limestone, mineral water.
--------	--------	--------	--------	629,216	--------	281,743 1,761,985	Clay and clay products. Cement, limestone, mineral water.
--------	--------	--------	--------	646,369	--------	1,374,496	Clay (pottery), cement, limestone, mineral water.
--------	--------	--------	--------	708,159	--------	1,836,020	Clay (pottery) and clay products, cement, limestone, mineral water.
[2]294,938	$391,922	[3]3,286,545	$135,782	$7,878,959	--------	$16,225,567	

Geology.

That portion of the Coast Range within Contra Costa County has been studied in detail by the Department of Geology and Paleontology of the University of California, and the southwestern portion has been mapped by Lawson.[1] A detailed list of references will be found in State Mining Bureau Bulletin 72, Geological Formations of California.

A nearly complete section of the Coast Range formations from the Franciscan to the Recent are exposed within the county, but as the area is one of many faults, no single formation is continuous over a large area. The most abundant strata are sandstones and shales of Cretaceous and Tertiary age.

MINERAL RESOURCES.

Contra Costa County contains no great variety of commercial minerals. It is particularly lacking in deposits of valuable metals, but on the other hand its structural materials on account of their easy accessibility and proximity to the cities surrounding San Francisco Bay are important natural resources. Its latent coal deposits, which were once the most productive in the state, are also of potential value. The most important minerals now produced are: cement, miscellaneous stone (crushed rock, sand, and gravel) and brick. Pottery clay, limestone, mineral water, and foundry sand are also on the commercial list. Other mineral resources include asbestos, coal, copper, diatomaceous earth, manganese, and quicksilver. Among those whose occurrences are probably only of mineralogical interest are fluorite, selenite, opal, talc, and numerous other rock-forming minerals.

The last general report upon the mineral resources of Contra Costa County is contained in State Mineralogist's Report XVII, 1920. In order to bring these data up to date in conformity with the new series of county reports begun in 1925, the writer visited the county in the latter part of January, 1927. All new developments and changes noted in the status of the industry are included herein.

The total value of minerals produced is unknown, as no segregated county figures are available prior to 1894. Records show, however, that coal alone to the value of at least $14,000,000 was taken out during that time. From 1894 to 1925, inclusive, approximately $30,000,000 in mineral wealth has been produced. In 1925 Contra Costa County ranked eighteenth among the fifty-eight counties in the state, with a mineral output valued at $2,544,179. The accompanying table gives the total recorded output from 1894 to 1925, inclusive.

ASBESTOS

In the so-called Diablo Mining District in Contra Costa County, mainly lying in T. 1 N., R. 1 W., and T. 1 N., R. 1 E., there have been noted occurrences of chalcopyrite, barite, cinnabar, fluorite, selenite, opal, chromite, manganese, asbestos, and other minerals. Some of these deposits occur on privately-held lands; mining claims have been located on other discoveries, beginning at an early date, but most of the deposits have proved to be superficial.

---

[1] Lawson, A. C., U. S. Geol. Survey, San Francisco, Folio 193.

A. Drumeller located some claims in 1925 on an asbestos deposit, described as being eight miles easterly from Clayton. The locality was not visited.

Bibl: State Mining Bureau Bull. 91.

BRICK AND TILE

Bricks have been produced in this county since 1896, if not earlier. In recent years building, roofing and art tile have been added to the output. Although a number of plants formerly in operation have ceased to exist, all of these products are now important items in its mineral industry.

California Art Tile Co. This company has a large plant on Hout's Spur of the Southern Pacific Railroad at Twenty-seventh and Main Streets, Richmond, where it manufactures Faience tile, Moorish tile and other ornamental art tile. J. W. Hislop is president; L. J. Hislop, secretary; W. A. Hislop, plant chemist, and C. E. Cummings, superintendent. Operations began in April, 1922, and have since been continued without interruption.

Plant of California Art Tile Company, Richmond, Contra Costa County

Clay from Lincoln, Placer County, and sand from Ione, Amador County are among the crude minerals utilized. Glaze materials are obtained in the east. The plant is equipped with four round downdraft kilns, each of 8000 square feet capacity. Oil is used for burning. An average of 30 men are employed.

Mastercraft Tile And Roofing Co. Office, No. 1, Twentieth Street, Richmond; C. V. and F. A Mero, owners. Cement roofing tile has been manufactured by this company for the past four years at its Richmond plant. During the past year hand-molded clay roofing tile has been added to their line. The clay tile plant is located on San Pablo Canyon road, near San Pablo, but the clay is obtained near Richmond.

Burning is done in a rectangular down-draft kiln using oil for fuel. Six men are employed.

Port Costa Brick Works. This plant is situated three-quarters of a mile east of Port Costa on the shore of Carquinez Straits. C. G. Berg, president; W. S. Hoyt, secretary; home office, 808 Sharon Building, San Francisco. Their products are common red brick and hollow building tile.

The raw material used is obtained from a high blue-shale bank 1500 feet from the water front. The shale is blasted down and loaded by a 1½-yard electric shovel into 5¾-yard hopper-bottom side-dump cars. These are hauled to the plant by a gas tractor, fitted with flanged wheels, or by an electric third rail system, as desired.

The stiff-mud process is used. Equipment includes a Hoffman continuous kiln and 11 field kilns, with a capacity of 400,000 brick for each type, giving the plant a maximum output of 60,000 brick and 60 to 100 tons of hollow tile per day. Both open-air or artificial drying with heated air is used, according to conditions. The dryer has a capacity of 40,000 bricks or their equivalent in tile. Petroleum coke is used for fuel in the Hoffman kiln. About 2000 tons are consumed per year, and it is said to be very satisfactory. Fuel oil to the amount of 15,000 to 20,000 barrels per year is used in the field kilns. Electric power from the lines of the Great Western Power Co. is supplied throughout the plant. There is a connected load of about 900 horsepower, but only 400 is used at present. Fifty to sixty men are employed.

Richmond Pressed Brick Co.'s plant; clay quarry in background. Point Richmond, Contra Costa County.

Bibl: State Mineralogist's Report XVII, p. 50.

Richmond Pressed Brick Co. The plant was erected by the Los Angeles Pressed Brick Company, but it became an independent company in 1921. It is situated at Point Richmond, near the Santa Fe-San Francisco ferry terminal, and is served by a spur track of the

Santa Fe railroad. S. W. Smith, president; W. S. Hoyt, secretary; F. M. Irving, plant superintendent; home office, Sharon Building, San Francisco. The output includes pressed brick, fire brick, face brick, paving brick, and floor tile.

For the light-colored and buff brick a portion of the raw materials used include clay and sand shipped in from Ione and Lincoln, as well as some sand from Antioch. Clay shale from the pit adjoining the plant is used for making dark-red brick. As the bank is high, the material drops to a loading bin after blasting. From here it is trammed a short distance in cars to the plant, which is equipped with a stiff-mud machine, capacity 100,000. Other equipment includes a Boyd brick press, capacity 16,000; and six 36′ down-draft kilns. Electric power is used to operate the plant and crude oil for burning. Fifty-five men are employed.

Other Companies.

Among the former brick companies that have ceased operations in the county are:

Mt. Diablo Pottery and Paving Brick Co.
Carquinez Brick and Tile Co.
Coast Firebrick Co.
Holland Sandstone Brick Co.
Diamond Brick Co.
Golden Gate Sandstone Brick Co.
Richmond Brick Co.
Gerlack Brick Co.

CEMENT.

Portland cement is the most important single structural material in the mineral output of the state. Eleven plants are now operating in nine counties. The presence of a large modern cement plant in Contra Costa County adds greatly to the rank of this county in respect to mineral production as cement exceeds all other mineral products of the county in annual value of output.

Cowell Portland Cement Co. S. H. Cowell, president; W. H. George, secretary and general manager; home office, No. 2 Market Street, San Francisco; C. D. Barnett, superintendent of plant, Cowell, California. Two products are made, 'Mt. Diablo' brand portland cement and 'Mt. Diablo' waterproof cement, manufactured under patents of the Pantheon process.

The plant is situated in Cowell at the base of Lime Ridge, about 10 miles southeast of Bay Point. It is connected by the Bay Point and Clayton Railroad, a standard-gauge line, with both the Southern Pacific and the Santa Fe lines at Bay Point. There is a good road from the highway at Concord, to Cowell. The quarries from which the limestone and clay are obtained are situated along the ridge back of the plant. The limestone occurs in irregular bodies along the Mt. Diablo fault, and is unique in being of algae formation and of such large size. An Armstrong all-steel well rig is used for advance prospecting, and deep-hole drilling for blasting. Large shots are used, the holes being loaded with 5% R. R. P. and 40% dynamite for priming. A Marion M 37 electric shovel with $1\frac{3}{4}$-yard bucket, revolving throughout a full

Plant of Cowell Portland Cement Co., at Cowell, Contra Costa County – Mt. Diablo in background. Photo by courtesy of the company.

circle, loads the broken rock into hopper-bottom cars, which are transported by locomotive to the crusher building. Here the rock goes to gyratory crushers, is passed through rotary screens and transported by belt conveyors to the storage bunkers. The crushed materials are drawn from these bunkers into gable-bottom cars and hauled by locomotive to the limestone, and clay and silica bins at the mill.

The raw materials from these bins are delivered by belt conveyors to the dryers. After drying they are taken by pivot bucket conveyors to either ball or swing hammer mills. The mills discharge to belt conveyors, which deliver to proportioning scales where each material is accurately weighed and correct amounts of each mixed together. The mixture is then conveyed to the raw tube mills where it is reduced to proper fineness and then conveyed to bins over the kilns. In the kilns it is sintered or burned to a clinker. The hot clinker is elevated and passed through rotary coolers and then conveyed by belt to the kiln clinker scales. It is weighed and then delivered to the clinker-storage which is under roof and has a capacity of 225,000 barrels. Clinker from any part of the storage space is conveyed to clinker scales where it is weighed and gypsum added from the gypsum scales. The combination is delivered to the finish ball mills and reduced to proper size for final grinding in the finish tube mills to pass standard specifications for fineness. The finished product is then delivered to any one of 40 storage bins of 3000 barrels capacity each. From these storage bins it goes to bins feeding Bates packers where it is sacked, or to barrel packers. In these forms it is loaded on cars or auto trucks. All operations are under strict technical control.

Armstrong all-steel drill used for advance prospecting and deep-hole blasting, Cowell Portland Cement Co. Photo by courtesy of the company.

There are eight rotary kilns, $7\frac{1}{4}'$ x 110′ in size; four rotary coolers, 5′ x 60′; 26 tube mills, as well as ball mills and hammer mills. Each unit is driven by an individual motor operating at 440 V., power being supplied by the Great Western Power Co. It is estimated that one horsepower is required for each barrel of cement produced. The capacity of the plant is 4800 barrels per day. From 200 to 235 men are employed.

Bibl: State Mineralogist's Report XVII, pp. 51-53.

CHROMITE.

Mt. Diablo Development Co., located a number of claims in T. 1 N., R. 1 W., comprising the Mt. Zion Chrome Mine. Some development work was done but the bureau has no record of any commercial production from the property.

Full-revolving type electric shovel loading limestone at quarry face. Cowell Portland Cement Co., Contra Costa County. Photo by courtesy of the company.

CLAY

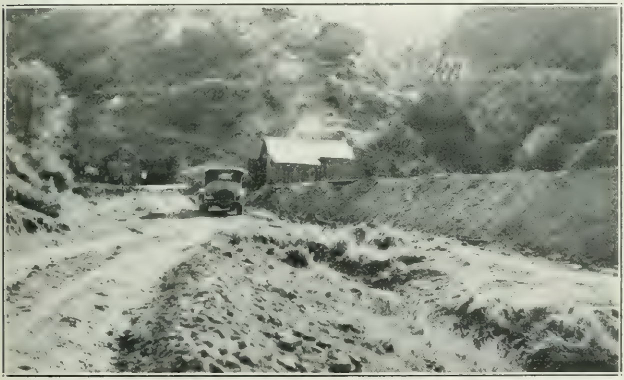
Leaving out of consideration the clay and shale used locally at brick and tile plants in the county, there is practically no clay mining industry, although one company is mining and shipping a clay shale to its plant in Alameda County.

The clay resources of this county have never been thoroughly investigated, but they are undoubtedly of considerable extent and value. Much of the peat and marsh land of the delta region and the flat area bordering on San Pablo Bay is underlain by a smooth, tough, sticky yellow clay. Samples of good plastic clays from this county, some fairly high in alumina, have been received in the bureau laboratory from time to time, but little development has resulted.

Some high grade clays are reported associated with the coal veins in the Mt. Diablo region.

Clark and Sons, N. This company quarries a calcareous clay shale at Walnut Creek and ships the material to their plant in Alameda, where it is used as a filler in pottery work. The shale is mined from a knoll alongside the Southern Pacific Railroad, one-half mile north of the town at Oxley siding. The surface portion of the deposit contains gravel mixed with soil, below which is a bed of clean shale. It is worked as an open cut, the face being about 200 feet wide and 70 or 80 feet in height. The material is taken out during the dry season and stored under roof for shipment. About two cars per week are sent out. When visited, there was no one at the quarry, but a loaded car was on the siding and there was other evidence of recent work.

Bibl: State Mineralogist Report XVII, p. 49; Preliminary Report No. 7, pp. 44-46.



Entry to Black Diamond Coal Mine of Southport Land and Commercial Co., Contra Costa County. The road shown at upper right, going up canyon, leads to sandstone bed mined for molding sand.

COAL.

Coal mining began in the Mount Diablo section of Contra Costa County at least as early as 1861, and the field has been the most prolific producer of any coal area in the state. From 1867 to 1882, inclusive, are records which indicate for the Mount Diablo field a total output of approximately 2,500,000 tons, valued at $14,300,000. Production practically ceased about 1902.

The coal deposits are found on the northeast slopes of Mount Diablo, about six miles south of Pittsburg. The main productive area extends from Sec. 7, T. 1 N., R. 2 E., westerly to Sec. 4, T. 1 N., R. 1 E., but definite evidence of coal has been found over a belt nearly ten miles in length. The coal belt strikes in a general east-west direction, and the veins dip north at an average angle of about 37°. Several large mines were opened, the leading companies being the Black Diamond Coal Company, the Union Coal Company, and the Pittsburg Coal Company. Two narrow gauge railroads were built into the district, one from Pittsburg Landing to Somersville, and one from Antioch to Stewartville. The old buildings and railroads are now dismantled and little remains to indicate the extent of former operations. There are three main veins which have been mined in the principal properties, the uppermost or Clark vein, next the Little vein, and the Black Diamond or lowest. The stratigraphic distance between the Clark and Black Diamond veins varies from 300 to 400 feet. The Clark vein has a thickness of 2½ to 4 feet, being nearly all clean coal with a good firm roof and floor of sandstone. The Little vein is thinner and more irregular, but reaches a width of two feet of good clean coal in places. The Black Diamond vein is much thicker, running from eight to eighteen feet in thickness, but there are many partings of slate and bone, which would have to be separated if the entire vein is mined. Clay gouge occurs along the walls, and on account of its character there is considerable swelling and movement, which add to the difficulty and cost of mining this vein.

Considerable literature has been published on the early coal mining operations in Contra Costa County. The beds have been described particularly by Goodyear[1], and Smith[2], as well as by others. The principal references are given in the bibliography herewith.

Southport Land and Commercial Company, 573-576 Mills Building, San Francisco; E. S. McCurdy, manager. This company owns several sections of land in the Mt. Diablo field, including the Black Diamond coal mine. For the past year several men have been steadily employed, cleaning out, retimbering and otherwise opening up the old Clayton tunnel. At the time of visit they were in about 1200 feet. The Clayton entry is run south as a crosscut, cutting all three veins. When the Black Diamond vein is reached the gangway turns east and follows the vein. As far as opened up on this level, the workings were dry and most of the timbers in an excellent state of preservation, though showing evidence of movement and crushing in places. The company is reticent as to its plans, but stated that many of the mine maps and records were destroyed in the San Francisco fire and that the work being done is of an exploratory nature to determine the location of old workings and shafts that will afford good ventilation. Air is supplied by a blower at present and a mule is used for tramming.

Modern methods of utilizing coals of this class lead to the belief that commercial production may again result from the work.

Bibl: State Mineralogist's Reports IV, pp. 14, 267; VI, p. 116; VII, pp. 117-146; VIII, p. 160; IX, p. 323; X, p. 165; XI, p. 191; XII, pp. 43, 64; XIII, p. 51; XVII, p. 53; U. S. Geol. Survey 22nd Annual Report, Part III, p. 500; Bull. 285-f; Min. Resources 1883, p. 20; U. S. Bur. of Mines Bull. 22, pp. 53, 395; Mineral Resources West of the Rocky Mountains by R. W. Raymond, 1874, pp. 39-42; Geol. Survey of California, Vol. II, pp. 3-34; Coal Mines of the Western Coast of the United States by W. A. Goodyear, San Francisco, 1877.

---

[1] Goodyear, W. A., The Coal Mines of the Western Coast of the United States, 1877; State Mineralogist's Report VII, pp. 117-146.

[2] Smith George Otis, U. S. Geol. Survey 22nd Annual Report, Part III, p. 500.

COPPER.

Chalcopyrite occurs with pyrite, in quartz, on Eagle Peak, Mount Diablo. Copper minerals have also been noted near Mount Zion, T. 1 N., R. 1 W. There was a small output in 1901 and 1918, but none since.

Bibl: State Mining Bur. Bull. 91.

DIATOMACEOUS EARTH.

That beds of diatomaceous earth occur near Pinole has been known for many years. A little of the material has been used in experimental work, but the deposits remain practically undeveloped.

Dohrman Deposit. A bed has been opened up on the property of the H. G. F. Dohrman Estate; address, Miss T. L. Dohrman, 2015 Franklin Street, Oakland. This property comprises 35 acres situated about one mile west of Pinole. It lies adjacent to the highway and is crossed by the Southern Pacific and Santa Fe Railroads. As yet it has not been developed on a commercial scale, but its proximity to the Bay region and excellent shipping facilities by rail or truck give it a potential value if the material is suited for industrial uses. A large quantity is reported to be available.

Pawsey Deposit. John Pawsey, of Pinole, owns six acres on the western edge of the town. The diatomaceous earth is exposed from the base to the top of the hills, indicating a considerable thickness to the beds. The material is cream-colored and rather tough, and was being quarried and used for road filling near Pinole at the time of visit. No technical use has been made of it up to the present.

LIME AND LIMESTONE.

Limestone outcrops conspicuously over a considerable area along Lime Ridge, in T. 7 N., R. 1 W. Burned lime was produced here by the Henry Cowell Lime and Cement Company previous to the erection of the cement plant by the Cowell Portland Cement Company. The Spreckels Sugar Company formerly operated a limestone quarry on the same ridge, about two miles south of the Cowell quarry, the limestone being shipped to the sugar refinery at Crockett and to the Selby smelter. This quarry was closed down in 1915 and their holdings sold to the Cowell Portland Cement Company. In 1924 the Mt. Diablo Lime Marl Company began producing limestone for agricultural purposes.

Mt. Diablo Lime Marl Co. R. L. Fry, president; G. A. Putnam, secretary, Walnut Creek; E. B. Bumstead, treasurer. The company's holdings consist of 51 acres situated on Lime Ridge about five miles northeast of Walnut Creek. The company has a plant for crushing, screening and sacking the ground material. Equipment consists of gyratory crusher, Grundler hammer mill and screens. For agricultural use the lime stone is ground so that 60 to 80% passes 100 mesh. It is hauled by trucks to the Southern Pacific railroad 1½ miles distant or to the San Francisco-Sacramento railroad, one mile distant. Two vertical kilns were placed on the property with the idea of producing burned lime also, but this type of kiln was found unsuited for burning the rock.

L. C. Hopper, Box 615, Concord, California, took the deposit and plant under lease in September, 1926. On account of wet weather, it was temporarily shut down at the time of visit. Four to eight men are employed when operating.

MANGANESE.

Some small bunches of manganese have been found on the south eastern side of Mount Diablo, but no commercial deposits have been developed. Manganese also occurs on Red Rock Island off Point Richmond. The deposit here is described by A. C. Lawson[1] as follows: "The ore occurs on the southwest side of the island as an integral part of the radiolarian chert. The chert here has a west-northwest strike and nearly vertical dip, and consists of the usual rythmical alternation of thin beds of hard, flinty to quartzose chert, and partings of shale, the whole having a reddish color. * * * A belt parallel to the strike of the chert includes interstratified layers of psilomelane, which, by reason of their black color, present a bold contrast to the adjoining rocks. Most of the layers are about one-fourth to one-half inch thick and replace locally the usual shale parting, but in places the psilomelane is much thicker. Some of the layers of the chert adjoining these layers of psilomelane are also so charged with that mineral as to be quite black, though they are still hard and siliceous. The psilomelane also occurs in minute particles in the shale between the chert beds, making it black. The borders of the belt in which these layers of psilomelane occur are not sharply defined, but the mineral has been mined in open cuts from two to six feet wide. The ore appears to be essentially a primary deposit, contemporaneous with the deposition of the silica that formed the cherts, although doubtless some of the psilomelane has since migrated into adjoining beds."

The deposit has been located as mining claims by Arthur B. Riehl, 1166 Washington Street, and Louis H. Eilken, 1373 Seventh Avenue, San Francisco; the island being government land. Should the manganese prove unmarketable, the associated red shales and jasper have commercial possibilities as mineral paint, roofing granules or stucco 'dash.'

MINERAL WATER.

Mineral water has been a commercial product of Contra Costa County for many years. The mineralized springs, notably Byron Hot Springs, is among the most popular and well-known resorts in the state, being easily accessible from the Bay region by automobile.

Alhambra Springs. Owner, Alhambra Natural Water Company, L. M. Lassell, Martinez, California. Six more or less mineralized springs are in this group, situated in a narrow canyon six miles south of Martinez in Sec. 2, T. 1 N., R. 3 W. Four of these have been developed. Water from No. 1, the most highly mineralized spring, was formerly bottled for medicinal purposes, but it is no longer used. Springs No. 2, 3 and 4 are only slightly mineralized and the water from these is piped to the bottling works at Martinez where it is used in the manufacture of soft drinks and bottled for drinking. It is distributed in five-gallon bottles. Tank-car shipments are made to Oakland and San

---

[1] Lawson, A. C., U. S. Geological Survey, San Francisco, Folio No. 193, p. 23.

Francisco. The total flow of the springs is about 150,000 gallons per month.

Analysis of Water from Alhambra Springs.

(Analyst, Thomas Price and Son; authority, advertising matter.)

	Grains per United States gallon	
	No. 1 Spring	No. 2 Spring
Calcium chloride	157.24	------
Magnesium chloride	24.25	------
Potassium chloride	7.58	1.395
Sodium chloride	492.65	2.028
Calcium bicarbonate	------	19.247
Magnesium bicarbonate	------	14.680
Sodium sulphate	2.48	15.548
Sodium sulphide	8.39	------
Ferrous carbonate	1.16	------
Aluminum oxide	------	0.238
Aluminum sulphate	2.13	------
Silicon dioxide	1.22	0.758
Total residue	697.10	53.894

Bibl: State Mineralogist's Reports XIII, p. 508; XVII, p. 56; U. S. Geol. Survey Water Supply Paper 338, pp. 293–294.

Byron Hot Springs. San Francisco office, 720 Phelan Building. These noted mineral springs are situated near the southeastern corner of Contra Costa County on the western edge of San Joaquin Valley in a saline flat, partly surrounded by low hills. They are one-half mile from the station of the same name on the Southern Pacific railroad, and are also easily reached by automobile over good highways. The distance from Oakland City Hall is 55 miles. The springs, eight of which have been improved, are described by Waring,[1] in part, as follows:

"A small warm sulphur spring supplies a drinking basin in the main grounds; warm sulphur mud and water baths and a sulphur plunge are about 250 yards southeast of the hotel grounds. A strongly sulphureted spring, 83° in temperature, forms a slightly used drinking pool at one side of Sulphur Plunge, and on the opposite side is a well from which mineral water is pumped to bathtubs in the hotel. In the summer of 1908 the water in this well stood about eight feet below the surface and its temperature was 112° to 115°. About 250 yards beyond the Sulphur Baths and Sulphur Plunge is an enclosed swimming pool, known as the Gas Plunge, in which the temperature is about 88°. Between the two bathing establishments are two cemented drinking springs, known as the Hot Salt and the Liver and Kidney springs. The Hot Salt Spring, with a temperature of 120° and a flow of about two gallons a minute rises in a small, domed, concrete house; the Liver and Kidney Spring rises in a concrete basin 25 yards southward. In 1908 its temperature was 73°, but its flow was not appreciable. Near the base of a low hill 250 yards to the southwest is a tile-lined basin or well, marked 'Surprise,' which contains strongly saline water about 70° in temperature."

The resort is equipped with a commodious modern brick hotel and bungalows. Tennis courts, a golf course and other amusements are provided for guests. A medical staff gives advice in the medical use of the various waters and baths. The so-called mud baths are in reality packs in a clean, flaky peat material rather than mud. The resort is open the year round.

---

[1] Waring, Gerald A., U. S. Geol. Survey Water Supply Paper 338, Springs of California.

Analyses of the water from Springs No. 1, 2 and 3, made by Curtis and Tompkins, in 1911, are shown below. Authority, advertising matter. Expressed in grains, per gallon.

No. 1 "Hot Salt" Spring		No. 2 "Liver and Kidney" Spring		No. 3 "White Sulphur" Spring	
The water has a temperature of 122 degrees F.		The water has a temperature of 58 degrees F.		The water has a temperature of 70 degrees F.	
	Grs. per Gallon		Grs. per Gallon		Grs. per Gallon
Ammonium chloride	1.78	Ammonium chloride	2.23	Ammonium chloride	0.02
Lithium chloride	4.20	Lithium chloride	0.72	Potassium bromide	0.16
Potassium bromide	1.55	Potassium bromide	1.59	Potassium iodide	0.16
Potassium iodide	1.24	Potassium iodide	1.26	Potassium chloride	0.37
Potassium chloride	2.13	Potassium chloride	3.18	Sodium chloride	17.92
Sodium chloride	572.00	Sodium chloride	639.52	Sodium metaborate	1.47
Sodium metaborate	4.29	Sodium metaborate	6.14	Sodium sulphide	0.88
Magnesium chloride	24.95	Magnesium chloride	29.57	Sodium sulphate	5.13
Calcium chloride	106.00	Calcium chloride	81.21	Sodium carbonate	1.38
Calcium sulphate	Trace	Calcium sulphate	Trace	Sodium bicarbonate	19.71
Calcium phosphate	Trace	Calcium phosphate	Trace	Calcium phosphate	0.10
Calcium bicarbonate	10.42	Calcium bicarbonate	18.85	Magnesium bicarbonate	3.07
Ferrous bicarbonate	0.47	Ferrous bicarbonate	0.60	Calcium bicarbonate	3.47
Barium bicarbonate	0.68	Barium bicarbonate	0.86	Ferrous bicarbonate	0.28
Strontium bicarbonate	0.12	Strontium bicarbonate	0.13	Barium bicarbonate	
Silica	1.74	Silica	1.80	Strontium bicarbonate	
				Silica	2.70
Total	731.57	Total	787.66	Total	56.82
GAS		GAS		GAS	
	c. c. per liter		c. c. per liter		c. c. per liter
Free carbon dioxide	4.45	Free carbon dioxide	7.23	Free carbon dioxide	None
Free hydrogen sulphide	0.41	Free hydrogen sulphide	0.28	Free hydrogen Sulphide	16.7

Ferndale Springs. Consists of two carbonated springs which issue from a thick sandstone stratum on the south side of Vaca canyon about six miles south of Martinez. The water from the principal spring was formerly marketed by the Richmond Soda Works, 1134 Ohio Street, Richmond, for drinking purposes, but it is not now being utilized.

> Bibl: State Mineralogist's Report XVII, p. 60; U. S. Geol. Survey Water Supply Paper 338, p. 208.

Pine Canyon Sulphur Spring.[1] "A moderately sulphureted spring emerges about four miles in a direct line northward from Danville, in Pine Canyon, which is at the western base of Mount Diablo. The water forms a clear pool, about 15 inches wide and 4 feet long, in thick bedded sandstone at the southern side of the creek. The yield is larger than is usual for springs of this class, being estimated at five gallons a minute, and the temperature of the water (67°) is also somewhat above the normal. The spring has not been improved, but it has been visited by occasional picnic parties. There are seepages within five yards of the spring, and 1½ miles farther eastward, upstream, sulphureted water seeps from a bluff on the northern side of the creek. Only one spring of appreciable flow was observed along the canyon, however."

Sulphur Spring Near Walnut Creek.[2] "A group of sulphur springs lies near the northeastern base of a low ridge about two miles northeast of the town of Walnut Creek. The largest spring is on the ridge about 100 yards from its eastern base and 25 yards north of the county road. When the place was visited, the water rose in a board-curbed pool protected by a latticed house and was piped to a cattle trough a few yards away. It yielded about three gallons a minute of mildly sulphureted water, 81° in temperature" * * *. "Five other smaller springs issue in a belt extending 350 yards along the base of the ridge, in and near the barnyard of Sulphur Springs farm. Two of them have been piped to water troughs near by. The other three are of seeping flow and form only small marshy places.

---

[1] U. S. Geol. Survey Water Supply Paper 338, p. 270.
[2] U. S. Geol. Survey Water Supply Paper 338, p. 270.

"The ridge is composed of sandstone the dip of which is nearly vertical, and strike S. 30° E. (magnetic) along the trend of the ridge. The steep inclination of the beds shows that intense movement has taken place here, and a fault . . . extends along the border of the valley land. This structural break probably accounts for the rise of the springs and also for their thermal character."

MOLDING SAND.

The growth of the iron and steel industry on the Pacific coast has created a demand for foundry sands, and deposits of sand suitable for brass, iron, and steel casting have been developed in various parts of the state to meet this demand. A large portion of that used at plants in Contra Costa County is obtained within the county.

Columbia Steel Corporation. For a number of years this company obtained sand for its molding department from a surface deposit situated about three miles west of Brentwood on the Marsh Creek road. This deposit has been abandoned and for the past three years it has used sand from a deposit on the property of the Southport Land and Commercial Company at Nortonville. The material mined is a cream-colored, soft, friable sandstone, immediately overlying and forming the roof of the Clark coal vein on the above property. This sandstone is very uniform and is said to run 96% silica. The bed averages about 70 feet in thickness, strikes east and dips north at an angle of 40°. A large entry has been run in westerly, from which open stopes or rooms have been mined out to the south following the bedding plane up. Pillars are left to support the roof, which stands well. Most of the mining is done during the summer season. The material is hauled to the Pittsburg plant by trucks.

PEAT.

The thickest deposits of peat in the state are believed to underlie the area following a line traced around the edges of the marshes and extending from Carquinez Straits to Stockton to Rio Vista and closing at the point of beginning. Peat beds within this area average six to 80 feet in depth. That portion of the county lying northeast of the Santa Fe railroad is largely peat land. Some peat has been dug and shipped from Werner and Orwood. It has not been utilized for fuel or industrial purposes in this state up to the present time.

PETROLEUM.

The possibilities of oil production in Contra Costa County are discussed by Vander Leck[1] in Bulletin 89, pp. 60–61. As this bulletin is out of print, his conclusions are included herein. He says, "The strata exposed constitute a nearly complete section of the Coast Range formations from the Franciscan to the Recent. Structurally, these beds have been sharply tilted, folded and faulted into a large number of more or less independent geological areas. This has resulted in preventing any one formation from being continuous over a large area, which is an unfavorable condition for the accumulation of petroleum.

---

[1] Vander Leck, Lawrence, Petroleum Resources of California, Cal. State Mining Bur. Bull. 89, 1921.

"Those formations within the county which contain beds that might form oil, consist of an area of Chico shales on the north side of Mount Diablo; a small area of middle Eocene organic shales (Meganos) in the vicinity of Mount Diablo and finally an area of Monterey diatomaceous shale in the San Pablo and Rodeo valleys just east of the Berkeley Hills. However, none of these organic shale beds are continuous over a sufficiently large area to form any great amount of oil.

"Indications of petroleum are found along the north side of Mount Diablo, about seven miles due south of Antioch; and in the San Pablo Valley, east of the Berkeley Hills.

"The Mount Diablo indications consist of small intermittent seeps of light green oil, found in the vicinity of Oil Canyon, Long Valley and Deer Valley. Roughly, the territory embraced by the seepages and wells that have found small showings consist of Secs. 13, 14, 15 and 23, T. 1 N., R. 1 E. The formations exposed consist of beds of sandstone and shale of the Chico, dipping in a monocline of about 65° to the north. Beds of Eocene age overlie the Chico along the ridge north of Oil Canyon. Prospecting for oil in this district was first started in 1864, when several wells were drilled in either Sec. 13 or 14 to a depth of about 300 feet and encountered slight showings of green oil. In 1900 another attempt was made and several more wells were sunk to shallow depths and obtained small showings. The last well was drilled by the Atlas Development Company in 1918 on Oil Creek, in the SE$\frac{1}{4}$ of Sec. 15, T. 1 N., R. 1 E. A depth of 1823 feet was reached and as no showings of oil were encountered the well was abandoned. About 1500 feet up the canyon and due east along the strike of the formation from the Atlas well, is an old hole known as the Harding well. This was drilled to a depth of 978 feet and encountered green oil from 950 to 978 feet. It is now used as a water well and shows about one quart of green oil per day. There is no reason to believe that future drilling in this region would show any better results than the former attempts.

"Indications in the San Pablo Valley consist of seepages of heavy black asphaltic oil found in the vicinity of Lauterwasser Creek and in the lower end of the valley about two miles east of the town of San Pablo. A detailed geological map of this territory can be found in folio 193[1] and Arnold gives a brief description of the geology and development in Bulletin 304.[2]

"The structure in the vicinity of Lauterwasser Creek consists of a rather sharply folded anticline plunging to the southeast and truncated at the northwest end by a fault. The oil has collected in the sandy beds of the Orinda formation (Pliocene), having been formed in the underlying diatomaceous shale beds of the Monterey series, which at this point are about 300 feet thick.

---

[1] A. C. Lawson, United States Geological Survey folio 193.

[2] R. Arnold. Miner Ranch Oil Field. Bulletin 304. U. S. Geological Survey, 1907, Pages 339-342.

Beginning in 1889 and continuing up to 1900, eight wells were drilled on this structure, the depths ranging from 500 to 2700 feet; all encountered showings of oil and gas, but none showed sufficient quantities to be of commercial value. At the lower end of the San Pablo Valley about three miles east of the town of San Pablo, five wells were drilled to 1900 feet along a syncline in the Orinda formation. Slight showings of oil were encountered, but nothing of commercial value was developed. The oil has apparently collected in the sands of the Orinda formations from the Monterey diatomaceous shale, which outcrops to the east on Sobrante Ridge. Neither the geological conditions nor the results of wells drilled warrant any further attempts at development in this area.''

Undiscouraged by past failures to obtain commercial production, a number of companies have started prospect wells in the county during the past few years and drilling is at present in progress.

From September, 1923, to December 31, 1926, the following notices of intention to drill were filed with the Department of Petroleum and Gas of the State Mining Bureau:

Year:	Company:	Location: Sec.	T.	R.	Well No.
1923	Elsinore Oil Co. of Nevada	19	2	1	--
1924	Leachman and Marshall—Acolanes Ranch near Tunnel road		1	3	--
1924	Wm. Edwards	31	2	2	1

Bibl: U. S. Geological Survey, San Francisco Folio 193; Bull. 340; State Mineralogist's Reports X, p. 165; XIII, p. 571; State Mining Bur. Bull. 19, pp. 156–157; Bull. 69, pp. 442–443; Bull. 89, pp. 60–61.

QUICKSILVER.

The *Ryne Quicksilver* mine, situated four miles southeast of Clayton, was a producer in 1875, 1876 and 1877, and at one time it is said to have produced as high as 85 flasks per month. The deposits are of very limited extent, however, and there has been no activity for years.

Bibl: State Mineralogist's Report VIII, p. 162; State Mining Bur. Bull. 27, p. 195; Bull. 78, p. 41; U. S. Geol. Survey Mon. XIII, p. 378.

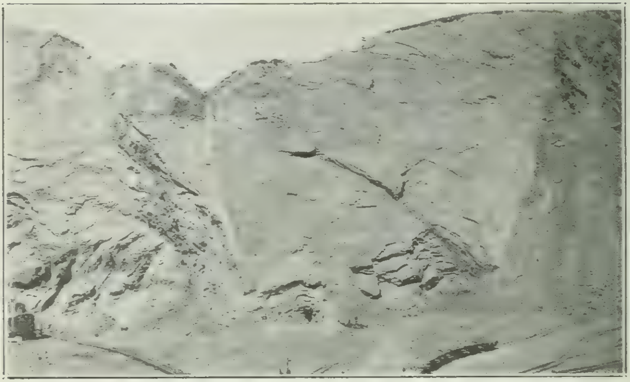
STONE INDUSTRY.

(Crushed Rock, Sand, and Gravel.)

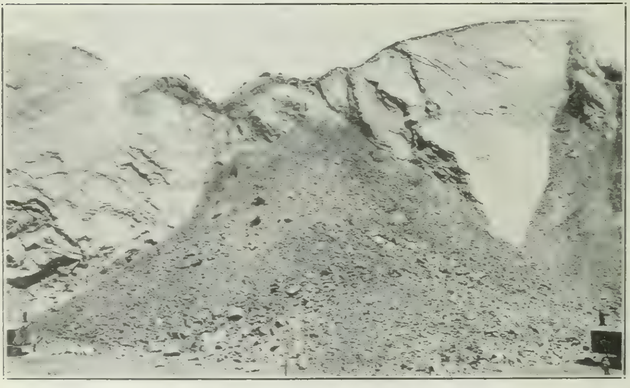
The production of the common structural materials in Contra Costa County, grouped under the heading 'Stone Industry,' has grown from a small beginning 30 years ago to a place second only to cement in value. The excellent transportation facilities afforded by water, rail, and highway and the proximity of the deposits and quarries to the metropolitan area around San Francisco Bay promise a steady growth to this important branch of the county's mineral industry.

CRUSHED ROCK.

Blake Bros. Co. (Blake Bros. Quarry); Anson S. Blake, president; H. Steinbech, secretary; home office, 204 Balboa Building, San Francisco; J. Asmussen, quarry superintendent. Blake Brothers operate



Quarry face before blasting, showing Coyote tunnel containing charge. Height of face at lowest point 220 feet. Blake Bros. Quarry, Contra Costa County. Photo by courtesy of the company.



Same face after blasting. Charge 18,200 lbs. of 10% Judson and 20 lbs. of 40% for priming. Coyote tunnel 60 feet in length with drift to left 16 feet and drift to right 85 feet. 100,000 tons broken. Blake Bros. Quarry, Contra Costa County. Photo by courtesy of the company.

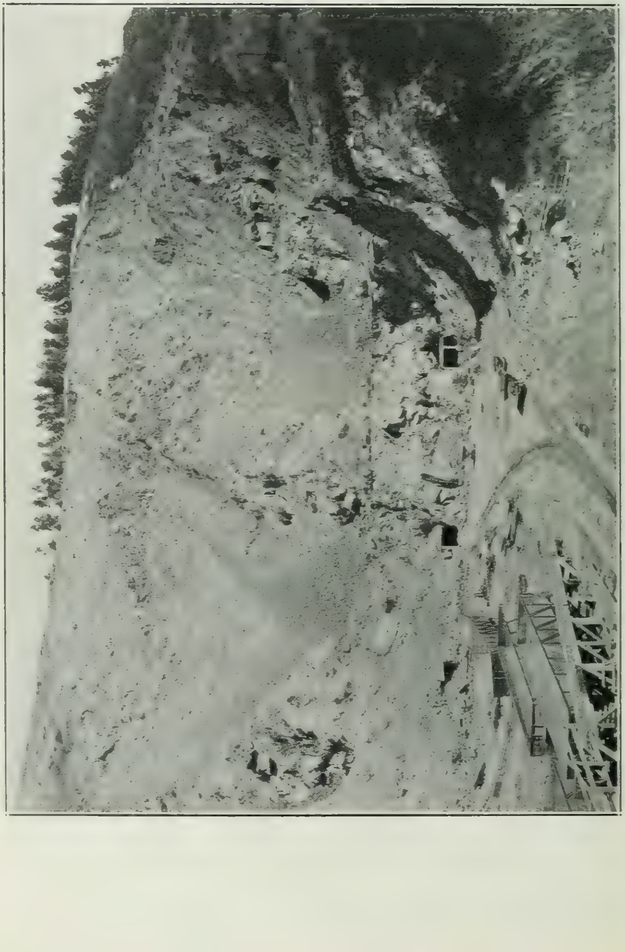
but a single quarry, which is located at the foot of Standard Avenue, Point Richmond, near the Richmond-San Rafael Ferry landing. This quarry is in the same range of hills as the Richmond Quarry of Hutchinson Co., Inc., and the old abandoned Point Molate quarry. The rock formation at Blake Brothers' quarry is very regular, consisting of hard blocky gray siliceous sandstone or trap rock. It has been opened up by a very large circular open cut with high face. A steam shovel is used to load the broken rock into 3½-yard bottom dump cars of special design, which are hauled to the crushing plant by steam locomotives. The plant has been in operation since 1907, and is built in two parallel units so that each may be operated independently. Electric power is used throughout with separate motors for all drives. Increased demand for special sizes of crushed rock has been met by the installation of new crushing, sizing and bunker equipment, including rolls for fine crushing, an innovation in plants of this character. Most of the output was formerly shipped by barge but since the completion of the Richmond Belt Line Railroad to the plant, shipments by rail and water are about equal. There is bunker storage for 24,000 tons. The plant is rated at 150 tons per hour capacity, and fifty men are employed.

Bibl: State Mineralogist's Report XVII, pp. 63-64.

Brooks Island Quarry. Healy-Tibbetts Construction Co., 64 Pine Street, San Francisco, operates a large quarry on Brooks Island, off Potrero Point, Contra Costa County. The quarry is operated primarily to take care of the company's contracts, but rock is also sold to other consumers. The quarry is equipped with a crushing and sizing plant of about 1000 tons daily capacity, but only riprap is being produced at present. The rock has been used recently for fills at the Carquinez bridge; on the Hetch Hetchy project at Dumbarton and at Pier 45, San Francisco. The material quarried for riprap is a buff-colored stone. A blue metamorphic sandstone of better quality is mined when crushed rock is produced.

Central Construction Co. (formerly Bates and Borland). J. E. Bowersmith, president; P. R. John, vice president; S. M. Chalmers, secretary; home office, 528 Oakland Bank Building, Oakland. This company has three quarries, their Stege Quarry in Contra Costa County and two in Alameda County.

Stege Quarry: This quarry has been worked for over twenty-five years. It was closed down in 1918, but reopened in 1922. It is situated near the top of the Berkeley Hills ridge opposite Stege (El Cerrito) at an elevation of close to 1000 feet. The crushing plant and bunkers are at the base of the ridge and are easily visible from San Pablo Avenue. Quarry and plant are connected by a gravity tram 4960 feet in length. The rock at the quarry is a hard blue metamorphic sandstone, but is not uniform throughout the deposit, and selective quarrying is necessary to obtain the best rock. It is mined by tunnels and glory-holes, using air drills and jackhammers. A Fordson tractor with flanged wheels hauls the loaded cars to the bunker at the head of the tramway. The tram has three rails above and two below the halfway passing point and two 5½-yard cars are used, the loaded car pulling up the empty. Speed is controlled by brake bands at the top. The wood brake shoes formerly wore rapidly, but by lubricating with water



El Cerrito Quarry of Hutchinson Co., Inc., Contra Costa County. Photo by courtesy of the company.

mixed with a small amount of kerosene, their life has been increased to months instead of days. At the foot of the tram, the cars dump to a bin, which feeds a No. 5 gyratory. The discharge is elevated by a bucket elevator to a revolving screen 20′ x 40″ in five sections. Oversize goes to two No. 3 gyratory crushers and then to a second revolving screen 20′ x 40″, in five sections. The following sizes are produced: 2½″-1½″; 1½″-1″; 1″-¾″; ¾″-¼″; birdseye; ¼″-dust; dust and waste.

The bunkers have a capacity of 2000 yards. A spur of the Santa Fe runs to the plant and cars or trucks may be loaded direct. There is also yard storage. Electric power is used, about 200 horsepower being required. The plant has a capacity of 350 yards per eight-hour day. An average of twenty-two men are employed at the quarry and crusher. G. McColl, superintendent.

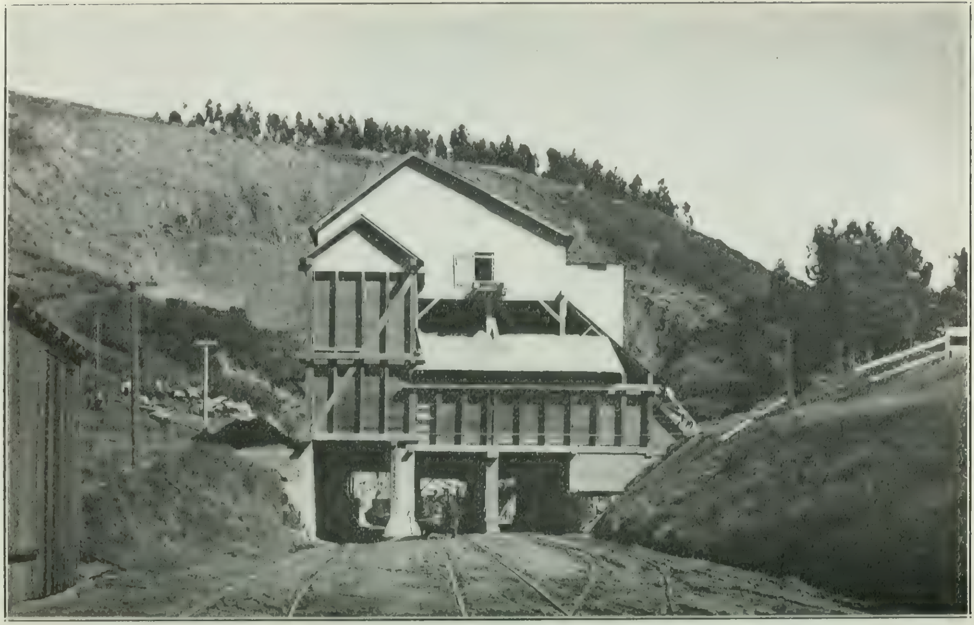
Bibl: State Mineralogist's Report XVII, p. 61.

Foot of tramway, crushing plant and bunkers, Central Construction Co.'s Quarry, Contra Costa County.

Christen Quarry. Owner, J. M. Christen, Pacheco. This is a small quarry in buff-colored sandstone, situated about one-quarter mile west of Pacheco. The rock has been used occasionally for macadamizing the roads in that district. Idle at the time of visit.

Hutchinson Company, Inc. Dwight Hutchinson, president; Hardy C. Hutchinson, secretary; home office, 1706 Broadway, Oakland; W. C. Collins, superintendent of quarries. This company operates four quarries and crushed rock plants, of which two are in Contra Costa County, one in Marin, and one in Santa Clara. The two in Contra Costa County are known as the El Cerrito (formerly Stege Quarry) and Richmond Quarry.

El Cerrito Quarry: This quarry is located at the base of the Berkeley Hills opposite El Cerrito and adjacent to the large sub-station of the Great Western Power Company, visible from San Pablo Avenue. The ridge here has an abrupt slope and the quarry face is high. The



El Cerrito Quarry of Hutchinson Co., Inc., showing crushing plant and bunkers. Quarry in background—Contra Costa County.
Photo by courtesy of the company.

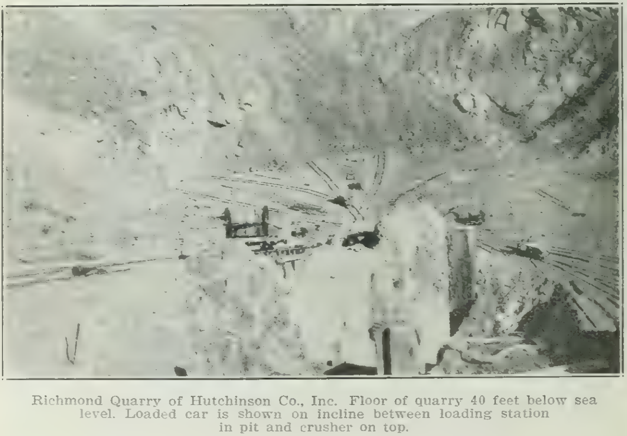
rock, which is usually classified as a hard blue metamorphic sandstone or 'trap' rock, is mined by two tunnels and glory holes. A Fordson tractor, running on rails, is used to handle the cars. These are dumped in a hopper discharging to an inclined belt-conveyor, which delivers the rock to bins feeding the crushers; or in wet weather the ore is dumped directly into the crushers which are set in pits. The primary crushing unit consists of two No. 5 gyratories. The discharge is elevated by bucket elevator, passes to two parallel 18′ x 60″ trommel screens. The oversize from the trommels goes to three No. 3 secondary gyratories. The discharge is again elevated and delivered to two sets of screens, a 10′ x 48″ trommel and a four-deck 3′ x 5′ Link-Belt Vibrator screen. The sizes segregated include: Rock dust, birdseye ($\frac{1}{8}$″ - $\frac{1}{4}$″), $\frac{1}{4}$″ - $\frac{3}{4}$″, $\frac{3}{4}$″ - $1\frac{1}{2}$″, $1\frac{1}{2}$″ - 2″ or $2\frac{1}{2}$″. The crushing plant and bunkers occupy the narrow gap leading into the open quarry and the tail tracks for the railroad cars run back on the quarry floor. Yard stock is handled by an oil-burning steam crane and oil-burning steam shovel. Electric power furnished by the Great Western Power Company is used. A total of 320 horsepower is required. A spur of the Santa Fe provides an outlet for rail shipments. Trucks may also be loaded from the crusher bin or yard bunkers. The plant has a capacity of 1000 yards a day. A total of thirty-six to forty men are employed.

Richmond Quarry. This quarry of Hutchinson Company, Inc., is located at the water's edge about half way between Richmond Point and Potrero Point. The quarry is unique in that the floor is at present forty feet below sea level with only a narrow rim of rock preventing entrance of the bay water. The material being quarried is a hard fine-grained blue metamorphic intrusive rock and is of excellent quality. A new incline is being sunk 35 feet deeper, which will eventually lower the quarry floor to about 75 feet below sea level. The pit is circular in outline. Toe holes twenty feet deep are put in and after blasting the rock from three sides of the quarry it is hand-trammed to a center dump sunk below the floor and timbered over. A two and one-half-ton skip receives its load here and is hoisted up an incline and automatically dumped into the crusher bins on the rim. The initial breaker is a No. 4 McCully gyratory. The discharge goes to a revolving screen and oversize from the screen to a No. 3 gyratory in closed circuit. The undersize goes to another sizing trommel. Oversize is returned to the No. 3 gyratory and $\frac{1}{4}$″, $\frac{3}{4}$″, and $1\frac{1}{4}$″ sizes are usually segregated. Other sizes may be produced if desired. A belt conveyor draws from the bunkers and loads direct to barges. A small amount is also handled by trucks and there is a spur of the Santa Fe within 100 yards. A small amount of sandy loam overburden and dust is washed out to waste by a Byron and Jackson 3″-centrifugal pump. Electric power from the P. G. & E. Company's lines is used, about 200 horsepower being required. The plant has a capacity of 300 yards per day. Forty men are employed.

Bibl: State Mineralogist's Report XVII, pp. 63, 65. The Explosive Engineer, Vol. 4, No. 8, August, 1926.

Slater Quarry. This quarry is a small one, situated on the same ridge as the Christen Quarry, about one-half mile south of Pacheco. It is worked intermittently for road use, but was idle at the time of

Richmond Quarry of Hutchinson Co., Inc. The quarry is to the left of crushing plant and bunkers, Contra Costa County.



Richmond Quarry of Hutchinson Co., Inc. Floor of quarry 40 feet below sea level. Loaded car is shown on incline between loading station in pit and crusher on top.

visit. There is a small outcrop of limestone exposed above the sandstone in the quarry.

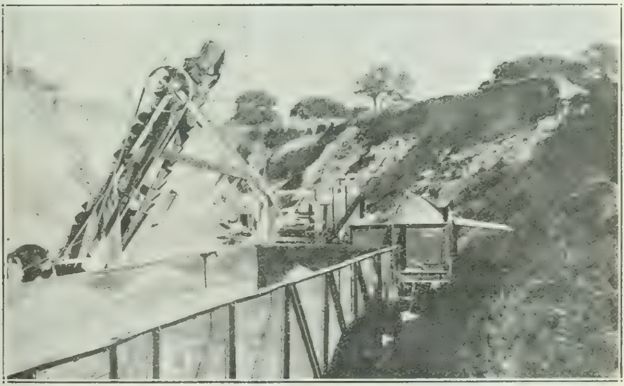
Bibl: State Mineralogist's Report XVII, p. 64.

GRAVEL.

There are no gravel screening or crushing plants operating in the county.

SAND.

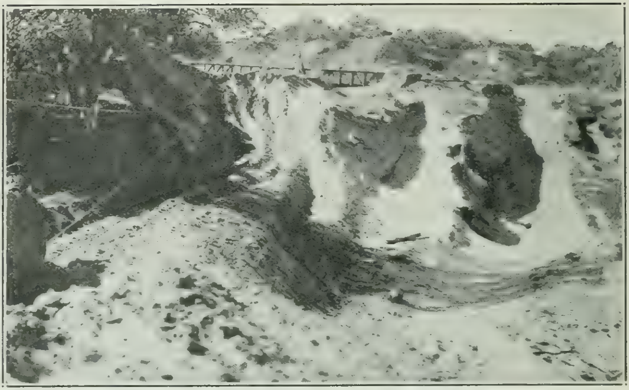
Dunes of fine sand border the south shore of the San Joaquin River between Antioch and Marsh Landing, a distance of about two miles. The Santa Fe tracks parallel the dunes most of the way. Early attempts to manufacture sand-lime brick were made here. These enterprises did not prove successful, although some of the brick are still in evidence and are said to be of good quality.



Sandpit of Antioch Sand Co., Contra Costa County.

Antioch Sand Company, Antioch; A. D. McCaddom, owner. This sand pit is situated about one mile east of Antioch. The deposit consists of clean fine dune sand. The face of the bank at present is about 50′ in height, but it has a depth of 120′ farther in. In parts of the deposit near the surface the sand is free flowing, but most of it has a tendency to pack and will not flow from a bunker, the angle of repose being practically vertical. The portion being mined is at present about 40′ in depth. Below this is a layer of 3′ of very fine tight sand, referred to as 'hard pan.' Underlying the above is a 3′ stratum of coarse sand, the bottom of which is 12 feet above high water level of the river. Very moist fine sand underlies the 3′ layer of coarse sand. The bottom of the pit is kept just above the 'hard pan' stratum.

The sand is delivered to a loading bunker by drag-line scraper. A bucket-elevator loader draws from the bunker and delivers to railroad cars. A small dryer has been installed at the plant and a portion of



Morris Sand Pit, Contra Costa County.

E. B. and A. L. Stone Co.'s sand pit, Contra Costa County.

the sand is dried and run over a Rotex screen producing a very fine product, 'sand dust,' which is sacked. Both the bank run product and the sand dust are used exclusively in asphaltic work. Electric power is used, about 80 horse power being required. Two to four men are employed, according to the season.

Morris Sand Pit. Benj. Morris, Box 845, Antioch, is producing sand from his pit a little farther east along the dune. He operates his own and also pits on the properties of R. B. Mitchell, 830 Powell Street, San Francisco, and Louise Schellet, of Antioch. The sand is elevated by an electric drag-line scraper and delivered direct to railroad cars on a spur of the Santa Fe, which runs to the pit.

E. B. and A. L. Stone Company; address, Claus Spreckels Building, San Francisco. This company operates a sand pit adjacent to that of the Antioch Sand Company. A 75-h.p. drag-line hoist is mounted on a platform over a spur track of the Santa Fe Railroad in the pit. The material is dumped direct to the cars. The bank here is about 70 feet high at present and the drag is 600 feet. Electric power is used. Only one man is required for operating.

Robert Easley and Jacob Bonslette, of Antioch, have erected a loading platform and hoist house and are preparing to produce from the dunes at a point just outside the eastern limits of Antioch.

Other idle deposits are owned by Arthur Frank, Box 185, Antioch; Nina Nason, Antioch; W. E. Buck, No. 2 Pine Street, San Francisco; Nat Cleaves, Antioch; and Lina M. Owens, 2524 Benvenue Avenue, Berkeley. The latter two properties are used as a park and beach.

LOS ANGELES FIELD DIVISION.

W. Burling Tucker, Mining Engineer.

MINERAL RESOURCES OF SANTA CATALINA ISLAND.

Santa Catalina Island is located south of San Pedro, and 18 miles beyond the mainland, and is under the jurisdiction of Los Angeles County. The island is approximately 25 miles in length and 7 miles in breadth, with an area of about 48,000 acres, its general physical characteristic being mountainous. The island may be considered as two islands joined together by a narrow neck of land. The largest of the two divisions contains about three-quarters of the whole area, and is traversed by a mountain ridge extending from the south in a northeasterly direction until nearing the east coast, when it turns west but does not cross the isthmus. Along the ridge that has a westerly trend are the principal peaks or highest parts of the island known as Ruby Hill, Black Jack Mountain and Razor Back Mountain. The highest point is Black Jack Peak, which has an elevation of 2000 feet, while the average altitude of the main backbone is from 1400 to 1600 feet.

The principal harbor is located at Avalon, where the famous summer and winter resort of the island is located. Avalon is situated on the southeast coast of the island, at the head of a small bay. The mouth of the bay is about one-half mile across, flanked on both sides by bluffs rising 300 feet out of the water. The distance around the bay is a little over one mile.

General Geology.

The main portion of the island consists of Franciscan formation while the other portion is made up of lavas and tuffs, chiefly andesite. In the vicinity of Black Jack and Ruby peaks, the formation consists largely of garnetiferous hornblende, although the immediate peaks are composed of volcanic tuff and lava. Northeast of Black Jack Mountain is a belt of micaceous schist. On the east coast of the island in the neighborhood of Potts' Valley, the bluffs are made up of trachyte. To the south of Potts' Valley, a quartzite dike runs down to the ocean separating the garnetiferous hornblende on the south from the metamorphic slates on the north. The veins that occur in the metamorphic schist trend north and south and have vertical dips. South of Avalon, in what is known as Renton Canyon, which has a southerly course from Pebble Beach, there are a series of parallel veins that occur in the earlier phase of andesite. These veins strike east and west, the most southerly known as the Renton vein system dips 60 to 70° north. The Quarry Vein dips 70° south. The ore consists of galena, sphalerite, and pyrite. The vein material of the Renton Vein series is made up of orthoclase, oligoclase, quartz, calcite, barite and muscovite. The material of the Black Jack Vein is made up of garnetiferous hornblende, quartz, calcite, barite and muscovite. The veins vary in width from 4 to 15 feet.

History.

Catalina Island was first discovered in 1542 by Captain Juan Rodriguez Cabrillo, a Portuguese navigator sailing under the flag of Spain. Later, in 1602, Sebastian Viscaino, a Spanish navigator visited the island, and christened it 'Santa Catalina Island.' Later, the island became the property of Mexico and was granted by Mexico to Pio Pico, Governor of California. Governor Pico later deeded the island to Nicholas Covarrubias. In 1863 it was purchased by James Lick, of San Francisco, and that year the first mineral was discovered on the island, considerable prospecting was done along the different veins, and the miners formed the San Pedro Mining District. The first claims were located in April, 1863, by Martin M. Kimberley and Daniel E. Way. The mining boom collapsed in 1864, due to an order of the United States Government for the miners prospecting on the island to leave. The island was purchased in 1887 by George R. Shatto. An English mining syndicate later took an option on the property, and during the tenure of their lease this company did considerable development, and it is reported, silver ore was shipped to smelters on the mainland. The English mining syndicate suspended operations in 1892 and the island was sold by Mr. Shatto to the Banning Bros. who turned it into a pleasure resort. In February, 1919, Santa Catalina Island was purchased by William Wrigley, Jr., of Chicago, Illinois. Mr. Wrigley expended a considerable amount of capital in developing Catalina Island, as a 'World Renowned Pleasure Resort.' Late in 1923, Mr. Wrigley started prospecting and exploration work on the different mineral showings on the island, and development work on the old Black Jack Mine located on Black Jack Mountain. The exploration of this property was encouraging and considerable ore has been developed.

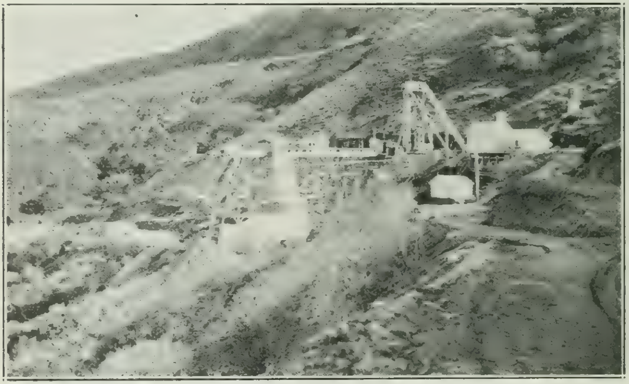
During 1924, 250 tons of ore were shipped from this mine to the Selby smelter, San Francisco. It is reported the ore averaged $50 per ton in lead and silver. In December, 1925, the company completed a 100-ton flotation plant for the treatment of the ore from the Black Jack Mine. The plant is located at White's Landing, 4 miles north of Avalon. In the early part of 1926, development work was started on the Renton Vein, which was discovered in the building of an auto road to this section of the island, and several other veins have recently been exposed that are parallel to this vein. The quarry vein was exposed in the rock quarry during the excavation of rock material, and development work on the vein has exposed a considerable tonnage of ore. Water for the island is supplied from wells and from a large dam located at Middle Ranch from which the water is brought by a 12-mile pipe line over the mountains to Avalon, insuring an adequate supply of water for all purposes. The mines are operated by the Santa Catalina Island Company, William Wrigley, Jr., president; D. M. Renton, vice president and general manager; David P. Fleming, secretary; and E. H. Pattison, engineer in charge of mining operations.

Mines.

Black Jack Mine. It is located on the northeast slope of Black Jack Mountain, 2 miles west of White's Landing, and 14 miles by road northwest of Avalon. Elevation 1540 feet.

The vein occurs in a belt of hornblende schist that strikes northwest and dips 70° east. The hornblende schist is exposed east of Black Jack Peak but is covered by a flow of andesite to the west. The vein trends N. 30° W., and dips 60° E. The width of the vein varies from 4 to 12 feet. The vein is mineralized with sphalerite, galena and pyrite. The gangue minerals are hornblende, quartz, barite, calcite and muscovite. The ore-shoot developed from the 400-foot level to the surface was 40 feet in length, and from 6 to 12 feet in width. This orebody carried higher values in lead, zinc and silver than the ore now being worked on the 500-foot level. From upper workings considerable high grade lead-zinc ore was mined and sorted for shipment. The ore developed on the 500-foot level is 100 feet in length, and has an average width of 25 feet. There is a possibility that this shoot of ore is of greater length as the face of the stope shows ore for the full width of 25 feet. The ore carries 6% zinc, 1½% lead, and from 2 to 3 ozs. in silver.

Development consists of a 3-compartment vertical shaft 525 feet deep, with levels driven on the vein at 400 and 500 feet. North of this shaft the ore was worked from No. 1 tunnel driven on the vein, through a winze to the 400-foot level with levels at 100, 200, 300, and 400 feet. A drift on the 500-foot level is 390 feet in length, of which 100 feet is in ore. The total amount of drifts and crosscuts amount to 4400 feet. The present daily production is about 40 tons of ore. Ore from the main shaft is trammed to ore bins having a capacity of 225 tons. The ore from bins is transported by aerial tram, a distance of 2 miles to storage bins at the mill located at White's Landing. The ore buckets have a capacity of 800 pounds each.



Head frame and ore bins. Black Jack Mine, Santa Catalina Island.

Equipment consists of 75-h.p. double drum electric hoist, Imperial Type X R. M.; Ingersoll-Rand compressor driven by 100-h.p. motor; blacksmith shop. Twenty-five men are employed.

Renton Vein Mine. It is located 2 miles southeast of Avalon, in Renton Canyon, which runs in a southerly direction from Pebble Beach. Elevation 700 to 1100 feet.

In this area five parallel veins occur in andesite. These veins strike east and west, and dip 60° north. The veins have widths varying from 4 to 6 feet. The main Renton Vein, in one place attained a width of

18 feet. The ore below No. 3 tunnel level is sphalerite and galena with silver values. It carries 8 to 12% zinc, 1½ to 2% lead, and 2 to 3 ozs. in silver.

Development consists of 4 tunnels on the main Renton Vein. At an elevation of 1085 feet, No. 1 tunnel is driven west 200 feet. At an elevation of 985 feet, No. 2 tunnel is driven west 225 feet. At an elevation of 879 feet, No. 3 tunnel is driven northwest 645 feet to the vein, and west on the vein 130 feet. At an elevation of 716 feet, No. 4 tunnel is driven south as a crosscut 400 feet to the vein, with a drift on the vein of 150 feet, developing a shoot of ore 130 feet in length with an

Outcrop of Renton Vein showing No. 1 and No. 2 tunnels, Santa Catalina Island.

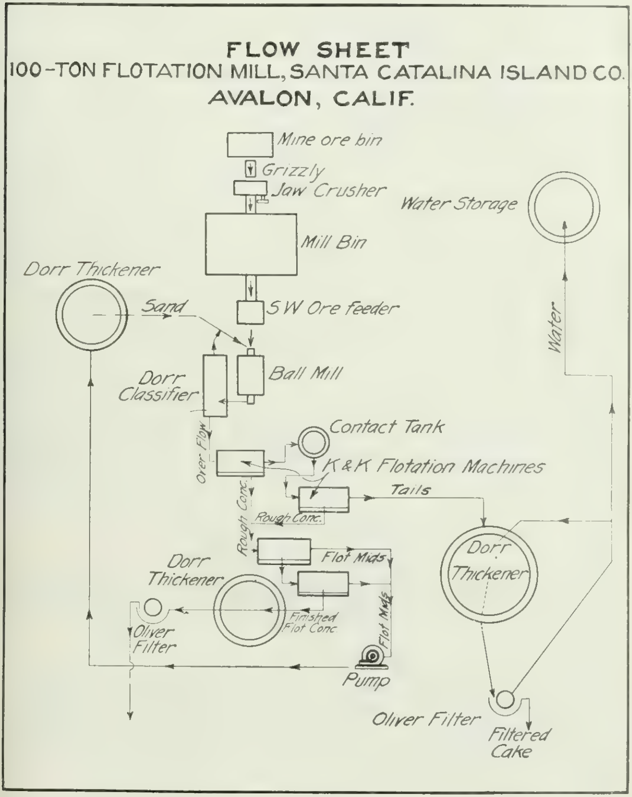
average width of 6 feet. At an elevation of 514 feet, No. 5 tunnel is driven west on a parallel vein, known as Wrigley Vein. Total drifting on this level is 630 feet, and two parallel veins have been developed that trend east and are 100 feet apart. The ore mined through tunnel No. 4 is trammed to ore bins having a capacity of 100 tons. From these bins it is transported over a jig-back tram, having a length of 700 feet, to an ore bin from which it is fed to a sorting belt, where waste is sorted out, the ore going to 100-ton storage bin. The ore from this latter bin is transported over aerial tram 3000 feet in length to a storage bin at Pebble Beach, which has a capacity of 225 tons.

Quarry Mine. It is located west of the Rock Quarry, 1¼ miles southeast of Avalon, and southwest of Pebble Beach. Elevation 300 feet.

The vein is exposed along the face of the quarry. It strikes east and west, and dips 70° south, and occurs in andesite. A number of north and south shear zones cut off the ore-shoot, but do not displace the vein to any extent. The vein was first developed from the level of the quarry floor by Tunnel No. 1. About 50 feet in elevation vertically below these workings No. 2 tunnel has been driven east 489 feet on the vein. At 310 feet from the portal, a winze has been sunk on the vein to a depth of 250 feet. Eighty-five feet below this level No. 3 level has been driven on the vein a distance of 340 feet. No. 4 level is 85 feet below No. 3 level, and the vein has been developed for a distance of 200 feet. The ore-shoot developed is 150 feet in length, and has an average width of 4 feet. This ore-shoot trends to the east. The ore carries 9% zinc, 1½ to 2% lead, and 3 ozs. in silver per ton. Ore is hoisted to No. 2 level to an ore pocket, and trammed to ore bins which dump over a grizzly. From here it goes to a sorting floor, where waste rock is sorted out, then to storage bins. The ore from this bin is hauled by truck to the main storage bins at Pebble Beach. From these bins, the ore from the Renton Vein and Quarry Mines is conveyed by belt conveyor to the main belt conveyor of the rock plant,

100-ton flotation mill, White's Landing, Santa Catalina Island.

which carries it to a barge having a capacity of 250 tons. This barge is towed by tug to White's Landing, a distance of 5 miles, where it is unloaded by bucket crane into a truck, which hauls the ore to storage bins above the mill.



100-ton flotation mill, White's Landing, Santa Catalina Island.

The flotation mill at White's Landing has a capacity of 100 tons per twenty-four hours, at present writing treating 130 tons of the combined ore from Black Jack, Renton Vein and Quarry mines. The mill storage bins have a capacity of 500 tons. The ore from these bins is fed to a belt conveyor in the proportion of $\frac{1}{3}$ Black Jack ore and $\frac{2}{3}$ Renton Vein Mine and Quarry Mine ore.

The ore is treated by flotation and concentration. The mill equipment consists of 10″ x 20″ Blake crusher, Marcy ball mill in closed circuit, with Dorr Simplex classifier; two Devereaux agitators, one for lead pulp, the other for zinc pulp; four 12-foot K. & K. flotation machines, two of which are used for lead product, and two for zinc product, consisting of primary and secondary roughers. One 6-foot K. & K. cleaner cell for lead float and two 6-foot K. & K. cleaner cells for zinc float; 4 Cottrell concentrators; battery of Wilfley pumps; 2 Dorr thickeners, one for lead concentrates, the other for zinc concentrates; 2 Oliver filters, one for lead and the other for zinc. Water supply for the mill is pumped from the ocean. Electric power for operating the mill is secured from the power plant at Avalon. Total horsepower required to operate mill is 225.

The ore treated at present carries from 7.2 to 8.7% zinc, 1.5 to 3.5% lead, and 3.5 ozs. silver per ton, the product produced being zinc concentrates, 45% zinc, 3.2% lead, and 11.5 ozs. silver per ton, and lead concentrates, carrying 55% lead, 8% zinc, and 93 ozs. silver per ton. Mill tails 2% zinc, 0.2% lead, and silver 0.9 ozs. per ton. Recovery is 80% of zinc, 82% of lead, and 80% of the silver. Production during 1926 was around 300 tons of zinc concentrates per month and 60 tons of lead-silver concentrates per month. Thirteen men are employed. Mr. Connor, superintendent.

The zinc concentrates are shipped to Belgium and lead-silver concentrates to the American Smelting and Refining Company's smelter at Selby, California.

Besides the above mentioned properties, considerable prospecting is under way on different parts of the island where vein outcrops show the presence of copper, lead and zinc ores. The principal areas being prospected are located southeast of Pebble Beach, and in the vicinities of Empire Landing, White's Landing and the isthmus.

NONMETALS.

CLAY.

In the vicinity of the Catherine Hotel and in other parts of the island are deposits, more or less limited in extent, that are suitable for the manufacture of tile.

MINERAL PAINT.

The occurrence of red and yellow ocher was noted along the oxidized croppings on the veins in Renton Canyon. Above No. 4 tunnel on the Renton Vein near the auto road to No. 3 tunnel, there is exposed a vein of red ocher that is 6 to 18 inches wide. Tests of the material are being made for its use as paint.

SOAPSTONE.

There is an extensive deposit of steatite located near the isthmus, at Empire Landing.

STONE.

The *Santa Catalina Island Company* owns and operates the Catalina Island Quarry located at Pebble Beach, one mile southeast of Avalon.

The quarry is 300 feet in elevation above sea level, and the rock being quarried is andesite. The broken rock is loaded from the quarry floor by two steam shovels into two trains of cars, hauled by Plymouth gasoline locomotives, to a primary crusher located high above the rest of the plant.

The crushed stone is transported in barges a distance of 30 miles to bunkers of Graham Bros., Inc., Long Beach. The plant has a capacity of 1000 tons per day, with a monthly output of 30,000 tons. One hundred men are employed at quarry and crushing plant. J. Forest, general superintendent. The company also has a large stone quarry at Empire Landing.

The writer wishes here to acknowledge his appreciation of the courtesy and cooperation rendered by Mr. D. M. Renton and Mr. E. H. Pattison and Mr. Connor.

Bibl: State Mineralogist's Report X. pp. 277–281.

OIL FIELD DEVELOPMENT OPERATIONS.

By D. R. Bush, State Oil and Gas Supervisor.

From October 31, 1926, to and including December 31, 1926, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Coalinga Empire Oil Co.	6	21	15	8	Coalinga
Zier Oil Co	1	20	14	N-6	Coalinga
KERN COUNTY:					
Bear State Oil Co.	30	28	21	15	Belridge
Carneros Oil Co.	31	28	21	3	Belridge
Carneros Oil Co.	31	28	21	4	Belridge
Carneros Oil Co	31	28	21	7	Belridge
Standard Oil Co.	31	30	25	Kern Co. Lease 1 25	Elk Hills
Union Oil Co.	26	30	24	Elk Hills 18	Elk Hills
Barnsdall Oil Co.	32	27	28	1	Kern River
General Petroleum Corp.	14	28	27	16	Kern River
General Petroleum Corp.	14	28	27	17	Kern River
General Petroleum Corp.	14	28	27	22	Kern River
General Petroleum Corp.	14	28	27	23	Kern River
George F. Getty, Inc.	22	28	27	Tegeler 1	Kern River
George F. Getty, Inc.	22	28	27	Tegeler 9	Kern River
George F. Getty, Inc.	22	28	27	Tegeler 10	Kern River
Gray Heirs	10	29	28	47	Kern River
Julian Petroleum Corp.	26	27	27	Fannie Higgins 1	Kern River
Skinner & Jasper	24	28	27	1	Kern River
Tarr & McComb, Inc.	2	29	28	10	Kern River
Universal Consolidated Oil Co.	32	26	21	46	Lost Hills
Universal Consolidated Oil Co.	32	26	21	47	Lost Hills
Safeway Oil Co.	20	30	22	3-A	McKittrick
Hugh B. Evans, Inc.	35	32	23	14	Midway
General Petroleum Corp.	32	31	24	Buena Vista 10-A	Midway
Gore Oil Co.	21	31	22	B-7	Midway
Gore Oil Co.	21	31	22	B-16	Midway
Gore Oil Co.	21	31	22	C-16	Midway
Gore Oil Co.	21	31	22	C-21	Midway
Gore Oil Co	21	31	22	C-23	Midway
Gore Oil Co.	21	31	22	C-25	Midway
Gralan Oil Co.	4	32	23	6	Midway
Honolulu Consolidated Oil Co.	8	32	24	29	Midway
Honolulu Consolidated Oil Co.	8	32	24	69	Midway
Honolulu Consolidated Oil Co.	8	32	24	79	Midway
Honolulu Consolidated Oil Co.	6	32	24	88	Midway
Midlands Oilfields Co., Ltd.	34	31	24	Thornber 8	Midway
Midway Peerless Oil Co.	15	31	22	8-X	Midway
North American Oil Cons.	32	31	24	8	Midway
North American Oil Cons.	28	31	23	15	Midway
North American Oil Cons.	28	31	23	18	Midway
Standard Oil Co	33	31	24	9	Midway
Standard Oil Co.	5	32	24	10	Midway
Standard Oil Co.	17	32	24	32	Midway
Standard Oil Co	17	32	24	34	Midway
Standard Oil Co.	17	32	24	38	Midway
Standard Oil Co	31	31	24	63	Midway
Standard Oil Co.	17	32	24	69	Midway
Union Oil Co.	32	31	24	Buena Vista 5	Midway
Shell Co.	9	27	28	Vedder 3	Mt. Poso
Midway Northern Oil Co.	32	12	23	16	Sunset
The United Oil Co.	32	12	23	Triangle 2	Sunset
Carolina Western Oil Co.	7	29	21	1	Temblor
Milham Exploration Co.	8	28	23	Kern 1-A	
Oildale Oil Co.	13	27	18	1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KINGS COUNTY:					
General Petroleum Corp.	30	23	19	Burbank 1	------
LOS ANGELES COUNTY:					
California Well Drilling Co.	11	4	13	Del Amo Estate 1	Dominguez
Shell Co.	33	3	13	Reyes 35	Dominguez
Shell Co.	34	3	13	Reyes 36	Dominguez
Union Oil Co.	33	3	13	Callender 16	Dominguez
Standard Oil Co.	17	2	14	Baldwin-Cienega 32	Inglewood
Standard Oil Co	17	2	14	Baldwin-Cienega 33	Inglewood
Standard Oil Co.	16	2	14	Baldwin-Cienega 81	Inglewood
Standard Oil Co.	17	2	14	L.A.Invest. 1 51	Inglewood
Standard Oil Co.	16	2	14	Stocker 9	Inglewood
California Petroleum Corp.	19	4	12	Harlow Kent 8	Long Beach
E. B. Campbell and H. R. McMillan	29	4	12	1	Long Beach
Tom J. Cannon	29	4	12	1	Long Beach
Graham & Loftus Oil Co.	19	4	12	Lightburn 3	Long Beach
Italo-American Petroleum Corp.—Modoc Petroleum Corp.	19	4	12	Italo 3	Long Beach
A. T. Jergins Trust	19	4	12	20	Long Beach
A. T. Jergins Trust	19	4	12	21	Long Beach
Macmillan Petroleum Products Co.	29	4	12	5	Long Beach
J. E. O'Donnell	19	4	12	O'Donnell 57	Long Beach
Rainbow Petroleum Co.	19	4	12	Dutcher 1	Long Beach
Signal Syndicate	19	4	12	1	Long Beach
The United Oil Co.	19	4	12	Hass 11	Long Beach
Barnsdall Oil Co.	18	3	13	O'Dea 15	Rosecrans
L. F. Bassett and Blaine White	7	3	13	1	Rosecrans
Circle Oil & Gas Co.	23	3	14	1	Rosecrans
E. L. Cragen	7	3	13	1	Rosecrans
General Petroleum Corp.	18	3	13	Vaughn 5	Rosecrans
Julian Petroleum Corp	35	2	14	Smith 1	Rosecrans
Kohlbush & Johnston	7	3	13	5	Rosecrans
C. S. Akers	3	3	12	1	Santa Fe Springs
California Petroleum Corp.	6	3	11	Matern Three 9	Santa Fe Springs
F. W. W. Drilling Co	5	3	11	1	Santa Fe Springs
Fred W. Roberts	5	3	11	S. F. Springs 1	Santa Fe Springs
C. C. M. O. Co.	9	4	14	Del Amo 61	Torrance
C. C. M. O. Co.	16	4	14	Del Amo 64	Torrance
C. C. M. O. Co.	16	4	14	Del Amo 65	Torrance
C. C. M. O. Co.	8	4	14	Del Amo 66	Torrance
C. C. M. O. Co	15	4	14	Torrance 70	Torrance
Main Oil Co.	8	4	14	3	Torrance
Clearwater Petroleum Co.	16	3	12	2	------
Haskell M. Greene	12	1	12	1	------
Keck Investment Co.	18	4	17	Pena 1	------
MONTEREY COUNTY:					
Petroleum Securities Co.	2	22	9	Aniotzbehere 1	------
ORANGE COUNTY:					
Brea Canon Oil Co	2	3	10	41	Brea Olinda
General Petroleum Corp.	6	3	9	Tonner 7-A	Brea Olinda
Shell Co.	1	3	10	Fisher 6	Brea Olinda
Shell Co.	2	3	10	Pico 6	Brea Olinda
Union Oil Co.	8	3	9	Olinda 3	Brea Olinda
Ahlburg Oil Corp.	10	6	11	5	Huntington Beach
Ahlburg Oil Corp.	10	6	11	A. & T. 3	Huntington Beach
Ahlburg Oil Corp.	10	6	11	Abel 2	Huntington Beach
Ahlburg Oil Corp.	10	6	11	Davis 11	Huntington Beach
Ahlburg Oil Corp.	10	6	11	Hume 4	Huntington Beach
California Petroleum Corp.	10	6	11	Brockman 1	Huntington Beach
California Petroleum Corp.	10	6	11	Farwell 1	Huntington Beach
California Petroleum Corp.	10	6	11	Fee 2	Huntington Beach
California Petroleum Corp.	10	6	11	Fee 3	Huntington Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Continued.					
California Petroleum Corp.	10	6	11	McLachlen 1	Huntington Beach
Coast Line Oil Co.	10	6	11	1	Huntington Beach
Dell Oil Syn. No. 2	10	6	11	Behr 1	Huntington Beach
J. Paul Getty	10	6	11	Hunt. Bch. 3	Huntington Beach
J. Paul Getty	10	6	11	Hunt. Bch. 4	Huntington Beach
Golden Rod Oil Co.	2	6	11	Golden Rod 2	Huntington Beach
W. A. Higgins	10	6	11	1	Huntington Beach
Jones Trust	10	6	11	1	Huntington Beach
Julian Petroleum Corp.	10	6	11	Bogan 1	Huntington Beach
Julian Petroleum Corp.	10	6	11	Lambert 3	Huntington Beach
Harry E. Macadam	10	6	11	1	Huntington Beach
McKeon Drilling Co., Inc.	10	6	11	Fee 2	Huntington Beach
The McKeon Oil Co.	10	6	11	Huntington 5	Huntington Beach
The McKeon Oil Co.	10	6	11	Huntington 6	Huntington Beach
Olympic Refining Co.	10	6	11	H. B. 9	Huntington Beach
Petroleum Securities Co.	10	6	11	Gries 1	Huntington Beach
Petroleum Securities Co.	10	6	11	Lewis 1	Huntington Beach
Richardson Oil Co.	10	6	11	9	Huntington Beach
Fred W. Roberts	10	6	11	H. B. 2	Huntington Beach
San Martinez Oil Co.	11	6	11	Hanke 1	Huntington Beach
Shoreline Oil Co.	10	6	11	2	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 27	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 28	Huntington Beach
Standard Oil Co.	10	6	11	Heffner 1	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 18	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 20	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 21	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 22	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 23	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 24	Huntington Beach
Standard Oil Co.	10	6	11	P. E. 3	Huntington Beach
Standard Oil Co.	10	6	11	P. E. 4	Huntington Beach
Sun Oil Co.	10	6	11	11	Huntington Beach
Superior Oil Co.	10	6	11	Gillette 6 2	Huntington Beach
Topeka Oil Co.	10	6	11	11	Huntington Beach
Transport Oil Co.	10	6	11	16	Huntington Beach
Transport Oil Co.	10	6	11	17	Huntington Beach
Travis Drilling Co.	10	6	11	H. B. 1	Huntington Beach
The United Oil Co.	10	6	11	Buck 2	Huntington Beach
The United Oil Co.	10	6	11	Dike 1	Huntington Beach
The United Oil Co.	10	6	11	Gay 1	Huntington Beach
The United Oil Co.	10	6	11	Stott 1	Huntington Beach
United States Royalties Co.	10	6	11	Lambert 1	Huntington Beach
H. L. Whiston	10	6	11	Geick 1	Huntington Beach
White-Smithson Trust	10	6	11	Schroeter 1	Huntington Beach
Hudson D. Wilcox	10	6	11	1	Huntington Beach
General Petroleum Corp.	33	3	9	Hugo 6	Richfield
Union Oil Co.	28	3	9	Ayers & Parsons 5	Richfield
Union Oil Co.	30	3	9	Chapman 26	Richfield
Union Oil Co.	29	3	9	Morse 7	Richfield
Union Oil Co.	28	3	9	Thompson & Goodwin 8	Richfield
Marland Oil Co.	11	5	12	Bixby 5	Seal Beach
Marland Oil Co.	3	5	12	Bixby 6	Seal Beach
Marland Oil Co.	3	5	12	Bixby 7	Seal Beach
Marland Oil Co.	11	5	12	Bixby 8	Seal Beach
Marland Oil Co.	10	5	12	Selover 2	Seal Beach
Marland Oil Co.	3	5	12	Selover 3	Seal Beach
Pan American Petroleum Co.	3	5	12	Naples 1	Seal Beach
Standard Oil Co.	3	5	12	San Gabriel 3	Seal Beach
Standard Oil Co.	11	5	12	San Gabriel 4	Seal Beach
Standard Oil Co.	3	5	12	San Gabriel 5	Seal Beach
Standard Oil Co.	3	5	12	San Gabriel 6	Seal Beach
Standard Oil Co.	3	5	12	San Gabriel 7	Seal Beach
Standard Oil Co.	10	5	12	San Gabriel 8	Seal Beach
Gaston A. Bastanchury	30	3	10	1	
General Petroleum Corp.	19	5	11	Lomita 1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
SAN LUIS OBISPO COUNTY:					
Brinkman Oil Co.	22	31	21	1	
E. T. Edwards	22	31	21	5	
Reliance Producers, Inc.	34	25	15	1	
SANTA BARBARA COUNTY:					
R. & G. Oil Co.	30	9	32	18	Cat Canyon
Miley Oil Co.	3	4	29	1	
SANTA CRUZ COUNTY:					
Cala-Cruz Oil Corp.	16	11	2	2	
Gerard Ryzek	14	11	2	1	
VENTURA COUNTY:					
New Hope Oil Co.	33	4	18	1	Piru
Temescal Petroleum Co.	3	4	18	Temescal 4	Piru
San Pedro-Pt. Fermin Oil & Gas Co.	13	4	21	2	Santa Paula
Oak Ridge Oil Co.	18	3	20	Willard 21	South Mountain
Union Oil Co.	13	3	21	Snyder 2	South Mountain
General Petroleum Corp.	21	3	23	Barnard 9	Ventura
General Petroleum Corp.	28	3	23	Barnard 12	Ventura
General Petroleum Corp.	21	3	23	Hisey 1-A	Ventura
Shell Co.	29	3	23	Taylor 16	Ventura
Shell Co.	28	3	23	Taylor 18	Ventura
Star Petroleum Co.	13	3	23	Star Canet 1	Ventura
E. A. Parkford	5	3	18	1	

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest: descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

HYDRAULIC MINING COMMISSION.

Following presentation to the Legislature of the report of the Hydraulic Mining Commission provided for in Chapter 270, Statutes of 1925, a bill was introduced in the Assembly (A. B. 681) by Mr. H. C. Cloudman to appropriate $200,000 to be used for the purchase of damsites and other necessary land to restrain tailings from hydraulic mining and operations. This would have enabled the testing of rock conditions at the damsites by drilling and the gathering of other necessary engineering data required before constructing the dams. The bill passed the Assembly, but failed by one vote in the Senate. However, the cause is not altogether lost, as much educational work has been accomplished, though much yet lies ahead before the goal is reached.

The United States Senate Committee on Commerce has requested the Chief of Engineers, U. S. Army, and he in turn has ordered of the California Debris Commission an engineering report on the several feasible damsites, with calculated capacities and costs; also estimated quantities of workable gravels that might be hydraulicked. Such work is authorized by and under the provisions of Sections 5 and 25 of the Caminetti Act. Had the Cloudman bill succeeded in passing there would have been made available to the California Debris Commission ample funds to carry on the survey and prepare their report within the coming biennium. As it stands, it may be longer delayed.

There having been only a limited edition printed of the report of the Hydraulic Mining Commission, primarily for the members of the legislature, and in consequence of numerous requests received by the State Mining Bureau for copies of this report, the State Mineralogist has deemed it advisable to reprint it in the current issue of MINING IN CALIFORNIA.

LLOYD L. ROOT.
May 1, 1927.

REPORT

OF THE

Hydraulic Mining Commission

UPON THE FEASIBILITY

OF THE

Resumption of Hydraulic Mining in California

A REPORT TO THE LEGISLATURE OF 1927

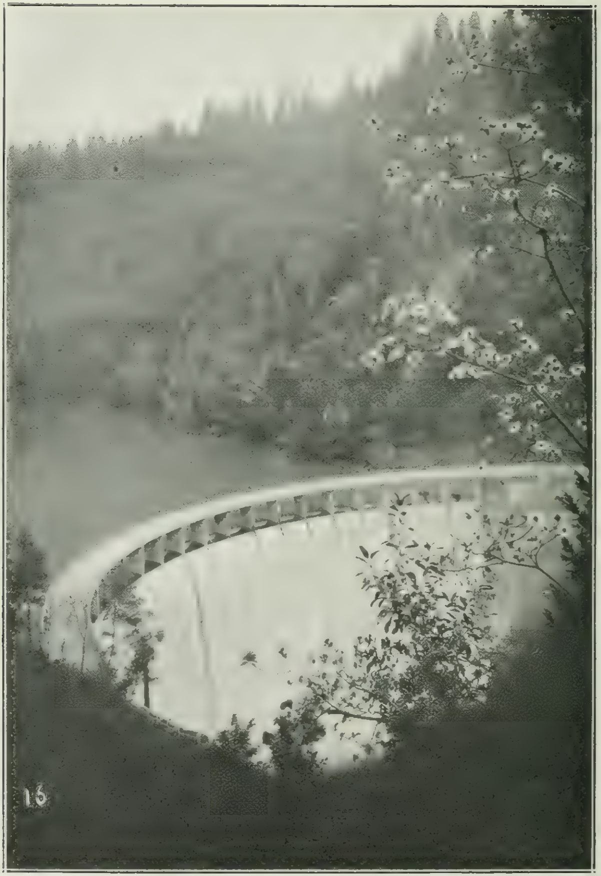


Photo by Arthur Jarman.

BULLARD'S BAR DAM.

On the North Fork of the Yuba River. Erected by Yuba River Power Company; completed January, 1924; effective height, 175 feet; length of crest, 520 feet; impounds 31,600 acre-feet of water. 10,000 horsepower is developed here and sold to the Pacific Gas and Electric Company for distribution. Mining is allowed behind this dam upon payment of a charge per cubic yard of gravel. Photo taken April 2, 1926. Flow of water, 1700 second-feet or 68,000 miner's inches. Water perfectly clear—suspended matter is less than 1 part in 10,000,000 of water.

LETTER OF TRANSMITTAL.

February 17, 1927.

To the Members of the Legislature,
State of California,
Session of 1927.

Pursuant to the provisions of Chapter 270, Statutes of 1925, calling for an investigation of the feasibility of any plan or plans whereby hydraulic mining can be resumed in California, this Commission, consisting of the state mineralogist and the surveyor general, engaged Mr. Arthur Jarman, mining engineer, to undertake the field work and prepare the technical report.

Hydraulic mining is regulated and controlled by the California Debris Commission under federal statute. That Commission offered their collaboration and assistance in the investigation, and have made surveys, capacity estimates and preliminary estimates of costs. Complete and cordial cooperation was maintained throughout the progress of the work; and our thanks are hereby tendered to Major C. S. Ridley, Secretary, and the other members of the California Debris Commission.

The investigation shows that hydraulic mining may be resumed, not only without fear of damage to farming and other interests, but with positive benefit to them, provided that impounding dams be constructed at strategic points, as shown on the map of the area under consideration. Preliminary estimates show that the erection of three dams and the purchase of storage in a fourth dam at a total cost of $2,405,000 would enable this industry to be resumed on the Bear, American and Yuba rivers.

Mr. Jarman reports that the available water will only suffice for one-fourth of the activity of the early '80's and that the shortage of water will mainly restrict work on gravels above the average in gold content. His forecast is an annual output of gold only one-seventh that formerly obtained from the district described. Approximately 10,000,000 cubic yards, estimated to yield $1,156,000, would be mined annually compared with 38,610,000 cubic yards in 1880, estimated to have yielded $8,000,000.

To restrain the gravel from mines in this district suitable sites for dams have been selected and surveyed and at each of these the rock conditions must be tested by drilling. Some detail surveys are also needed to supplement and check the data already obtained. This work is required on Lower Bear River site, two sites on the Middle Fork of the American River, two sites on the North Fork of the American River, and at the Narrows site on the Main Yuba. Six sites in all and possibly a seventh to enable a wise choice to be made for four dams.

This work is estimated to cost from $50,000 to $60,000 and until this preliminary engineering work has been carried out, it is not possible to decide the exact position for the construction of any dam or ascertain its cost closely enough to call for bids for its construction.

RECOMMENDATIONS.

State Legislation Required.

Assemblyman H. C. Cloudman was responsible for the bill that created this commission of investigation, and he has already introduced Assembly Bill No. 681, the object of which is to provide for the above work to be done.

Your commission recommends that the preliminary engineering to be done under this bill be done by the engineers of the California Debris Commission, as the Commission must certify to the utility and practicability of the storage sites, as provided in section 5 of the California Debris Commission Act.

The plans prepared for the construction of dams will be coordinated with those for the development and conservation of the water resources of the state, as outlined in Bulletin No. 12 of the Department of Public Works, recently issued. The dam at the Narrows will be so constructed that it may subsequently be raised to the maximum practicable height as forecast in that bulletin.

Upon receipt of favorable reports upon these damsites and of estimates of debris that may be allowed to be mined behind dams built thereon, and upon receipt of estimates of the costs of such dams this commission recommends that the balance of the moneys remaining unexpended under the appropriation named in this bill be utilized for the purchase of lands required as damsites and as areas to be flooded.

When estimates of the costs of dam construction on the Bear River and the North Fork and Middle Fork of the American River have been received, further legislation will be required to provide money for their construction, and vesting the debris storage in the California Debris Commission. Preliminary estimates indicate that $905,000 will suffice for these dams, including the $300,000 expenditure upon the damsites.

When the site at the Narrows on the Main Yuba has been drilled and plans for the proposed dam confirmed as suitable by the California Debris Commission and the allowable yardage of debris calculated therefor, legislation will be needed to provide a sum of $1,500,000 to purchase the total debris storage that can be obtained there by the erection of a dam to a crest elevation of 520 feet. This is in accordance with the letter printed on p. 35 of this report. This dam will provide a large amount of storage at a low price, which will enable the large low-grade gravels of the Yuba to be worked. No other dam sites examined showed costs that would enable these gravels to be worked, as revenue from power developable was too small in each case.

The total expense anticipated is therefore $2,405,000, and should be provided one-half by the State and one-half by the Federal Government as was done for the protection work on the Yuba above Marysville quoted on p. 13 of this report.

Federal Legislation Required.

Your Commission recommends Mr. Jarman's suggestions that legislation be introduced in Congress to enable the California Debris Commission to purchase debris storage in a dam in lieu of actually building a dam.

Also to amend the manner of charging a mine for restraining its debris in such a dam, or in a dam built by the Commission, by making a charge per cubic yard of debris discharged from the mine in such manner that it will be restrained in whole or in part by the dam, credit being given for boulders and material permanently stacked at the mine.

Also to provide that the charge to be made per cubic yard shall be calculated so that the capital cost of the dam shall be returned by the mining of the yardage of debris estimated by the California Debris Commission as restrainable by the dam. The total cost of the dam would be divided by the allowable yardage of debris in order to ascertain the charge to be made per cubic yard. The existing provision of a charge of 3 per centum of the gross proceeds of a mine is much too small, producing only one-third of the cost in most cases.

The sections of the Caminetti Act which provide for the protection of river channels and lands adjacent thereto should remain unaltered, and the above are the only recommendations made that affect this Act.

Benefits to Be Obtained by the Adoption of the Above Program.

1. Revival of Nevada and Placer counties, due to useful and productive work, requiring the employment of a considerable number of men in mining and other work dependent upon it.
2. Benefit to Marysville, Sacramento and San Francisco, due to orders for piping and mining machinery, materials and supplies, timber and general merchandise.
3. Development of additional water supplies for mining that will be stored in the higher regions and released as used for mining. This will assist all plans for water conservation at lower elevations, and tend to reduce salinity in the lower reaches of the Sacramento River.
4. The effects of the above will be felt as soon as the construction of dams is started. The miners will prepare for work by driving tunnels and repairing sluices and refitting their mines as soon as it is assured that debris will be stored at a reasonable price so that hydraulic work may be resumed with due protection to farm lands below.
5. Natural debris will likewise be prevented from being carried downstream and this will benefit the navigable channels by reducing the amount of dredging required. Dredging on the Sacramento River costs 6 cents per cubic yard, and the cost of restraining debris by a dam is less than one-third of this.
6. The Narrows Dam near Smartsville will render available considerable power and also water. The latter will be at an elevation of 520 feet, enabling it to be distributed over a large area of land with great benefit to the district below.

Respectfully submitted.

LLOYD L. ROOT,
State Mineralogist,
W. S. KINGSBURY,
Surveyor General,
Commissioners.

CALIFORNIA HYDRAULIC MINING COMMISSION—1925.

February 1, 1927.

THE HON. W. S. KINGSBURY, Surveyor General,
LLOYD L. ROOT, State Mineralogist,
Commissioners.

GENTLEMEN: This report has been delayed owing to the time required for calculating the impounding capacities and construction costs of dams upon various damsites considered. The figures were received from the California Debris Commission on January 26, 1927. They are estimates of impounding capacities and preliminary estimates of the costs of dam construction. They are given on pages 36 and 37.

The surveys and calculations involved much careful and detailed work and without this cooperation on the part of the California Debris Commission it would have been impossible for me to have formulated for your consideration the plan now submitted. In these surveys and estimates we are particularly indebted to Mr. R. L. Egenhoff, Engineer to the California Debris Commission, and to Mr. Harold F. Grey, in charge of the survey parties.

Because dams for the retention of hydraulic mining debris should be constructed, maintained and administered by the California Debris Commission to insure the protection of navigable channels and lands below, and because of the benefits to the state by the revival of mining and other industries involved, it is recommended that the State and Federal Government combine to provide the dams recommended.

Payments made by miners for the retention of their debris by these dams will constitute a revolving fund for the continuance of their work under the control of the California Debris Commission under the provisions of sec. 23 of the Caminetti Act of 1893. (See p. 16 of this report.)

The recommendation now made is that a sum of $300,000 be appropriated for preliminary engineering necessary to obtain precise data upon those damsites that give promise of favorable results upon Bear River, and the North Fork and Middle Fork of the American River, and to acquire the lands affected. Detail surveys are required on these sites and drilling to ascertain rock conditions to enable final estimates of dam construction to be calculated. If this work be started in the spring of 1927 it could be completed in that year. The preliminary estimates just completed indicate that a sum of approximately $905,000 will provide dams for twenty years of hydraulic mining on these streams. The gold production from this work is estimated to exceed $8,000,000 in that time. Payments by miners for debris stored during this period will automatically provide capacity for further work.

In addition to the above it is recommended that storage be purchased in a dam to be constructed by a private corporation at the Narrows site on the Main Yuba River. The quantity offered for purchase is the total debris storage of a dam to be erected to a crest elevation of 520 feet above sea level, some water space being reserved for hydroelectric power and irrigation purposes. The calculation of debris capacity will be subject to approval by the California Debris Commission in the usual manner. Preliminary estimates show 350,000,000 cubic yards and a cost of $1,500,000. The balance of the cost will be carried by the power and irrigation features of the project. This is a much greater amount of storage than could be obtained for the same money at other sites surveyed on the Yuba. It will enable mines to work on both the South and Middle Yuba rivers. The production for 20 years is estimated at $14,000,000 from about 130,000,000 cubic yards of gravel. At the end of the 20 years there will still be space in this reservoir for another 20 years of work at the same rate.

The storage would be vested in the California Debris Commission and would be paid for by mines operating behind the dams according to the yardage of gravel washed each season, as measured at the mine, credit being given for material permanently stacked at the mine, the surveys being made by the Commission or as directed by the Commission. Power to purchase debris storage in lieu of erecting a dam would have to be added to the Caminetti Act by Congress. It is also necessary to enact a new method of charging for impounding debris according to the actual volume of gravel discharged from the mine. The act now specifies a charge of 3 per centum of the gross output of each mine. This is so small that the dams would never be paid for.

It is now suggested that the charge for each river be determined separately, the basis being the return of the capital outlay by the time the allowable debris has been worked above the dam. In this report the dams have been calculated to allow 20 years' work. In the case of the Main Yuba River at the Narrows it would take 40 years of work at the rate calculated but the development of extra water supplies and improvements in methods would speed up this work and reduce the time. 300,000,000 cubic yards at $1,500,000 would be 0.5 cent per cubic yard which is low enough to insure the working of these low grade gravels. The determination of impounding costs must await the exact estimates of construction costs which can not be made until drilling has been carried out at each dam site.

The preliminary estimates of the above plan total $2,405,000. This initial outlay will enable hydraulic mining to be revived on the Bear, American and Yuba rivers to an annual production exceeding $1,150,000, and will provide for the gravel that will be mined in the first 20 years, and for a much longer period on the Middle and South Yuba rivers. The cost of the dams and purchased storage will be returned by debris impounding fees, which, under the Caminette Act, are used for maintenance and to provide additional storage as required.

This plan is feasible and can be carried out at much below the capital cost involved in any other plan that has been suggested as a solution of the troubles of the hydraulic miner. It deals only with gravel that can be mined with the existing water supplies.

Respectfully submitted.

ARTHUR JARMAN,
Secretary and Engineer to the Hydraulic Mining Commission.

ACKNOWLEDGMENTS.

Grateful acknowledgment is made to those who assisted in the gathering of data required and in facilitating the inspection of the gravels.

To Messrs. James D. Stewart of Auburn; Chester Bowman, John Ferguson and James Nelson McCormick of Forest Hill; Lyman Gilmore of Iowa Hill; Thomas B. Brady of You Bet; W. Maguire and W. W. Waggoner of Nevada City; Theodore Larsen and D. E. Bleakley of Washington and Omega, for assistance when inspecting the gravels.

For data and reports upon various properties thanks are tendered to Messrs. Malcolm Lindsay of Denver; J. Henry Schnitzel of Lead, South Dakota; F. A. Goodale of Los Angeles; James D. Stewart of Auburn; W. Maguire and W. W. Waggoner of Nevada City.

To Mr. Ernest A. Bailey, Flood Engineer, Sacramento, for enabling me to visit the flood control works from the mouth of the Sacramento River to the Tisdale Weir, most of this in his company, with the benefit of obtaining information on the flood control problem at first hand.

To Mr. W. T. Ellis, Levee Commissioner, of Marysville, for inspecting and explaining the flood protection system around Marysville.

To Mr. Paul Bailey, State Engineer, for cordial cooperation concerning the relations of the proposed plan to that proposed for the conservation of the waters of the state.

To Mr. Edward Hyatt, Chief, and Mr. Everett W. Bryan, Assistant Chief, of the Division of Water Rights, for information on the waters appropriated from rivers.

To the California Debris Commission for the preliminary estimates of costs of dams, without which this report could not have been made, and for the preparation of the map. Also, for the cordial manner in which this work has been carried out with full cooperation to make it of greatest benefit to the hydraulic mines of the district surveyed. For planning this work and supervising it, thanks are especially due to Mr. R. L. Egenhoff, Engineer to the California Debris Commission, also to Mr. Harold F. Grey, in charge of the field parties, and to both these gentlemen for calculations of capacities and costs.

To the Hydraulic Mining Commission, the Honorable W. S. Kingsbury, Surveyor General, and Mr. Lloyd L. Root, State Mineralogist, I wish to express my appreciation of the courtesies extended to me and for freedom of action in the conduct of the investigation.

ARTHUR JARMAN.

AN INVESTIGATION OF "THE FEASIBILITY OF ANY PLAN OR PLANS WHEREBY HYDRAULIC MINING OPERATIONS CAN BE RESUMED IN THIS STATE."

REVIEW OF THE PROBLEM.

Production in the Old Days.

As nearly as can be ascertained, in the palmy days of hydraulic mining the annual production reached $15,000,000 and averaged $10,000,000 for about thirty years immediately prior to 1884, when injunctions were issued to prevent the discharge of debris into the rivers.

Present Production.

By 1908, the total production for drift, hydraulic and other gravel mining had fallen below $1,000,000 due to the stoppage of hydraulic mining and the partial exhaustion of the richer drift mines.

In 1924, hydraulic mines, for the whole state, produced only $60,195* and in 1925 produced $175,345.

For the six years 1920 to 1925 hydraulic work averaged $122,114 per annum, and of this amount less than $60,000 was produced by counties that drain into the Great Valley of California. More than half of it was from counties that are not subject to restrictions because their rivers discharge into the ocean without navigable channels.

The drop from $10,000,000 to $122,114 per annum shows that hydraulicking has almost ceased and unless substantial assistance be given at an early date this industry will die as the remaining water resources will gradually be taken for other purposes.

Possibility of Reviving Hydraulic Mining.

A general revival is impossible because of the altered conditions of the times and because much of the water supplies that formerly belonged to hydraulic undertakings have been acquired by power and irrigation interests. Making allowance for these factors, there still remain some of the largest auriferous gravel deposits known to the mining world, and **the only process by which they can be worked at a profit is hydraulic mining.** A portion of the former water supplies is still available and would enable an industry to be built up with an annual production estimated at $1,156,950, so that in the next 20 years gold would be produced to a total value of over $23,000,000, but to accomplish this **the debris must be impounded at a low cost, otherwise more than one-half of the gravel would be unprofitable to work,** being of low grade. The provision of a substantial concrete dam on each of the main streams affords the only hope of securing impounding capacity at low cost, each dam serving several mines.

---

*See the returns given in Mineral Resources of the United States, 1924, Part I, by Jas. M. Hill, p. 212.

To accomplish this it will be necessary to activate the Caminetti Act in its entirety.

This act was passed by Congress in 1893, its proper title being "An act to create the California Debris Commission and regulate hydraulic mining in the State of California," approved March 1, 1893.

The condemnatory sections were utilized on the passage of the act. These provide more severe penalties than the state laws.

The permissive sections were also put into action. These allow the miner to build a dam and on its approval by the commission he may mine up to the limit of the capacity of the dam. Miners or others may combine to erect a dam to serve more than one mine. This provision has also been used and is in action.

The protective section, or the protective provision of section 25 provides that the commission shall build dams to prevent mining debris from injuring the navigable rivers. This provision was utilized between 1900 and 1910 by the erection of barriers on the Yuba and a "cut" and dam at Daguerre Point about nine miles above Marysville. This was done to protect the channels at Marysville and the adjacent farm lands, a matter of urgency because of the large quantity of debris in the channel. This work cost $661,824.14; one-half was paid by the state and one-half by the federal government.[*]

Up to July 1st, 1923, the federal government has expended	$398,268.67
The State has expended	398,656.39
A total of	$796,925.06[**]

The vitalizing sections, however, have lain dormant and unused. These provide that dams shall be built by the commission "**when appropriations are made therefor by law**" and that for the retention of debris by such dams the miner "**shall pay a tax of 3 per centum of the gross proceeds**" **of his mine so worked.**

Nothing has been done under these sections to provide dams for the resumption of hydraulic mining, nevertheless they point out the way to revive hydraulic mining, by enabling the mines of each district to work behind a common dam. The creation of the California Debris Commission, charged with the specific duties of examining dam sites and erecting dams when moneys are provided for them, simplifies the problem.

The recommendations that are made result from studies of dam sites and of gravels that would be benefited by dams in these positions. An account of this investigation follows the recommendations, and a short history is given of the growth and decline of hydraulic mining, followed by details of the principal gravels that are workable on each river under the plan now proposed.

The California Debris Commission's report upon dam sites, with their impounding capacities and preliminary estimates of costs is printed verbatim. The map that accompanies this report was prepared by them and on it are shown the chief gravels that are workable.

---

[*] See 1910 Report of Chief of Engineers, U. S. Army, pp. 1010-1011.

[**] See letter from the Reclamation Board of California to the Hon. C. F. Curry Feb. 1924, p. 54.

RECOMMENDATIONS.

1. As a result of surveys and calculations, five damsites were found to be unsuitable because of high cost per cubic yard of impounding capacity. Six showed promise of reasonable cost per cubic yard of gravel and it is recommended that detailed surveys be made of these and that drilling be done to ascertain rock conditions. If a start be made in the spring it would enable this work to be completed by the end of the year so that costs may be calculated and plans and specifications drawn up. This preliminary engineering is essential before reliable estimates for dam construction can be made. Under the most favorable circumstances and if funds were already available, no construction work would be possible before 1928.

2. The site at the Narrows on the Main Yuba requires drilling only to ascertain closely the cost of construction, but a low cost per cubic yard is assured from preliminary estimates. In this case revenue from power production and the sale of water for irrigation enables low cost to be obtained.

3. It is recommended that a sum of $300,000 be provided for preliminary engineering and for the purchase of damsites finally recommended.*

4. From $50,000 to $60,000 is estimated as sufficient for preliminary engineering on the seven sites to be examined and the balance of the $300,000 should cover the purchase of sites and lands when the most suitable sites have been determined. The engineering work now recommended will be a continuation of that done by the commission in 1926-1927.** The money required should be made available to supplement the annual congressional appropriation of $15,000 which covers the ordinary work of the commission and does not go far when special work of this kind is undertaken.

Discussion of These Recommendations.

When final estimates have been made, appropriations will be required to enable dams to be built and debris impounding capacity to be purchased by the California Debris Commission according to Table I which shows the output estimated for twenty years of work under this plan and the cost of debris storage according to the preliminary estimates, the total being $2,405,000 for the five rivers.

---

*Provided for by Assembly Bill No. 681, introduced into the State Assembly by Harold C. Cloudman, member for the 40th district, proposing to appropriate $300,000 for these purposes.

**The California Debris Commission is charged with the duty of examining dam sites under the Caminetti Act which says: "That it shall further examine, survey, and determine the utility and practicability, for the purposes hereinafter indicated, of storage sites. * * *"

TABLE I.

Estimate of Dams Required for Twenty Years' Work.

River	Amount of gravel estimated to be washed in 20 years (cubic yards)	Debris capacity of dam (cubic yards)	Preliminary estimates of total cost of dam	First cost in cents per cubic yard of gravel	Name of dam site	Particulars of dam
North American	23,000,000	21,000,000	$470,000	[1]$2 24	Owl Creek	Dam crest 137 feet above low water.
Middle American	13,280,000	22,000,000	125,000	[1]0 94	Mammoth Bar	Dam crest 45 feet above low water.
Bear	26,510,000	21,000,000	310,000	1 47	Lower Bear River	Dam crest 143 feet above low water.
South Yuba	85,392,000	preliminary	estimate			This dam site is below the junction of the Middle and South Yuba and will serve both streams. Dam to be built to 220 feet above low water.
Middle Yuba	52,000,000	[2]350,000,000	[3]1,500,000	under 0 50	Narrows	
Totals	200,182,000	400,000,000 +	$2,405,000			

[1] Another site is to be examined that should give lower cost.
[2] This figure not yet checked by the Debris Commission.
[3] For purchase of total debris storage capacity allowable.

The building of dams by the California Debris Commission is provided for by the act of 1893 which created the commission, but the alternative of purchasing debris impounding capacity in a dam built or proposed to be built in accordance with the commission's requirements has not been included, and an amendment would be needed to enable debris impounding capacity to be purchased by the commission. Table II shows that the charge of 3 per centum of the gross output of a mine for impounding its debris would not repay the first cost of the proposed dams. To accomplish this the method of charging should be changed by an amendment providing for a charge per cubic yard of gravel washed, credit being given for material stacked and retained at the mine.*

Table II also shows the charges per cubic yard required to return the capital cost by the time that the debris capacity of the dam has been mined.

---

*This is discussed further on page 17.

TABLE II.

Costs of Dams Compared with Debris Payments Calculated at Three Per Cent of the Probable Gross Yield and Compared with Debris Payments at Rates per Cubic Yard That Will Return the Costs
Results for Twenty Years' Work.

River	[illegible] debris	Dam [illegible] proposed rate per cubic yard	[illegible] rate in cents per cubic yard	Dam payments at three per cent [illegible]	Cost of [illegible]	Gold production [illegible]
North American	23,000,000	$515,000	*$2 24	$79,200	$470,000	[illegible]
Middle American	13,280,000	125,000	0 94	40,416	125,000	1,347,200
Bear	*(21,000,000) 26,510,000 expected	310,000	1 47	125,010	310,000	4,167,000
South Yuba	85,392,000	*686,960	[illegible]	449,544	[illegible] [illegible]	9,784,800
Middle Yuba	52,000,000				1,150,000	5,200,000
Main Yuba[1]					1,500,000	
Totals	200,182,000	$1,636,960		$694,170	$2,405,000	$23,139,000

*An additional site to be examined in each case with the object of obtaining lower cost on the North Fork of the American River, and a larger capacity on Bear River.

[1] Same figures as for Middle and South Yubas with some gravel below Freemans not estimated

The three dams originally considered on the South and Middle Yubas would have cost a total of $4,895,000 which is too high for work to be possible behind them on low grade gravels. Substitute for these three the purchase of storage on the Main Yuba at the Narrows for $1,500,000.

[2] Payments for the first twenty years only.

Payments for Impounding Debris From Mines.

A charge per cubic yard of debris discharged into the stream or channel is recommended. The act of 1893 stipulates 3 per centum of the gross production as payment for impounding debris. Unless the gravels are richer than 15 cents per cubic yard, the payments will only produce one-half cent per cubic yard. It has already been shown that the cost of providing impounding capacity is higher than this, leaving out of account the loss of interest on capital expended. Revenue derivable from water used for irrigation or for power production is discussed on p. 26, and is small for the dams considered because the effective height is small.

The dams proposed must develop storage capacity at low cost, otherwise the plan will not restore hydraulic mining because mining must pay the cost of storing the debris. Any plan which does not provide that mining shall pay for the actual storing of the debris is economically unsound. In the Caminetti Act, section 23 provides that "All sums of money paid into the treasury under this section shall be * * * expended by the said commission * * * in the construction and maintenance of such restraining works and settling reservoirs as may be proper and necessary."

In this manner payments for the storage or restraining of debris are utilized to provide new storage capacity as well as to maintain old dams, and if these payments equal the capital cost we shall have a revolving fund that will continue to provide the industry with settling reservoirs. But if the payments be insufficient to return the cost of providing dams, then the fund will diminish until extinguished.

The method of charging for this service is immaterial to the argument, but any amendment would require action by Congress.

The first calculations made for this report were based upon 20 years of work under the 3 per centum payments, and an inspection of

Table II shows that 3 per centum would be inadequate and the revolving fund would quickly disappear. If all gravels were charged the same rate per cubic yard the payments would be sufficient on some rivers and insufficient on others. It appears most logical to determine the charge at each dam irrespective of the charge made at any other dam because conditions differ on the various rivers.

Provision should be made for the receipt of revenue derivable from the sale of water for power production or for irrigation, and this should be credited to the state.

It is impossible to estimate exactly the yield from the gravels, therefore it is futile to calculate greater revenue derivable from a greater percentage charge. A charge per cubic yard of debris discharged into the stream or channel is rational, and it is suggested that this charge be based upon the return of the cost of the dam by mining the quantity of debris allowed to be mined behind it.

Where there is a large percentage of heavy boulders there is no sense in encouraging the discharge of such material into the water courses. In many cases it would be cheaper to stack this on the bedrock of the mine, using an electric derrick. When this is done, the survey should make an allowance for the quantity so retained on the bedrock of the mine. Such heavy material would never reach the dam but might reach the main water courses; stacking it at the mine should be encouraged and not penalized. If charged for as though retained by the dam the effect is to raise to a high figure the charge per cubic yard mined. This is not equitable, and may prevent the earning of a profit.

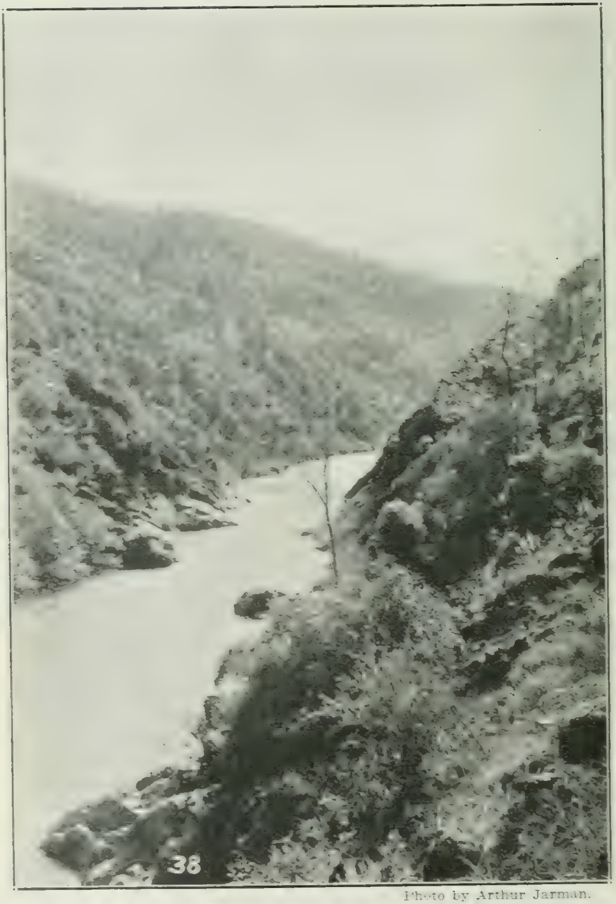


Photo by Arthur Jarman.

DAMSITE ON THE NORTH FORK OF THE AMERICAN RIVER.

View looking downstream from the north bank.

ACCOUNT OF THE INVESTIGATION OF DAMSITES AND IMPOUNDING COSTS.

It was anticipated that large dams at the sites first chosen would provide impounding capacity at low cost and enable mining to be developed on a scale that would be profitable. While surveys and calculations were in progress, further inspections of the gravels were made, to ascertain the gravel that would be worked and gold produced annually by mining behind these dams if impounding costs were favorable. In most cases a period of twenty years or more would be required to mine the gravel available with the existing water supplies and therefore costs were calculated for dams to provide capacity for twenty years work.

Choice of Dams.

Section 25 of the California Debris Commission Act directs that the recommendations already made concerning damsites shall be the basis for future work. Existing surveys were extended where necessary to gain additional impounding capacity. New surveys were also made.

Mr. A. L. Wisker, secretary-manager of the Nevada Irrigation District, supplied some engineering data on the Parker damsite on Bear River, and Mr. H. A. Kluegel, consulting engineer of San Francisco, cooperated by exchanging information on damsites on the North and Middle Forks of the American River. The capacities and preliminary estimates of cost given in this report are calculated by the Debris Commission engineer and in due course will be reported to Congress.

North Fork of the American River.

Three sites were considered. That at Owl Creek was favored because it will catch debris from Iowa Hill and from the north side of Forest Hill. That at Rice's Bridge on the road from Colfax to Iowa Hill was surveyed. This is a good dam site but would not catch Iowa Hill or Forest Hill material. Seven miles below Owl Creek is the North Fork site above the junction of the Middle Fork. This gives promise of lower costs than the other two sites. Each should be examined in detail. Preliminary estimates show costs of 2 cents or less per cubic yard of debris capacity. Calculations of impounding capacities were made as follows:

North Fork site—from private surveys.

Owl Creek site—from Debris Commission survey.

Rice's Bridge site—from surveys by the United States Geological Survey in cooperation with the State Water Commission, 1912.

Preliminary estimates of costs of dam construction were made as follows: North Fork site and Owl Creek site from private surveys, and Rice's Bridge site from the Debris Commission survey.

Middle Fork of the American River.

Calculations were made for a dam at Mammoth Bar or American Falls, utilizing for this purpose a survey made by the United States Geological Survey in cooperation with the State Water Commission, 1912, and a sketch map of the damsite made in 1890. A detail survey will be required. There is another site that offers cheap storage on this river which should be examined in detail.

Bear River.

Three sites had already been surveyed, Van Giesens, Parkers, and Lower Bear River, the figures favoring a dam at the Lower Bear River site. This will catch debris from Bear River, Steep Hollow and the Greenhorn. The canyon at this point is favorable for concrete dam construction. the preliminary estimates indicating a cost under 1.5 cents per cubic yard of debris capacity. The water level would be raised above that of the Pacific Gas and Electric Company's Bear River diversion dam and canal, thus giving settled water at the intake. When this dam is filled, it could be raised or further storage obtained in a dam lower down the river at the Parker site. Rock conditions at the Parker site were reported as not so favorable for a concrete dam as at the Lower Bear River site. Parker site has been purchased by the Nevada Irrigation District and preliminary estimates indicate that debris storage there would cost from 2 to 2½ cents per cubic yard, measured at the mine.*

South Yuba River.

Two sites were surveyed, both having excellent rock bottom and sides. Operations on this stream will be larger than on any other, therefore, it was originally intended that one dam be constructed at Norton's Cañon and a second one twelve miles lower down at Jones Bar. This was proposed because of the large amount of gravel that it is expected will be worked. Unfortunately the preliminary estimates for both these dams gave high costs per cubic yard of impounding capacity from 2.8 to 3.8 cents, which is much too high for gravel estimated to yield 10 cents which is the value of the Bloomfield gravel.

Middle Yuba River.

Two sites were surveyed, Freeman's and Emory's Flat. Preliminary estimates for cost of storage at Freeman's were 1.9 cents. Near Emory's Flat there is a rocky canyon but the rock is strongly jointed and might give trouble in obtaining a water-tight foundation. The impounding cost there was much higher than at Freeman's.

The principal object of a dam on the Middle Yuba is to enable the low-grade gravels at North Columbia and Badger Hill to be worked. These are of great size and are estimated to yield 10 cents, and an impounding charge of 2 cents would prevent them from being mined at a profit.

Dam on the Main Yuba at the Narrows Site.

Both the Middle and South Yuba rivers would be served by a dam at the Narrows. also some gravel on the Main Yuba below the dam sites mentioned above, but a very large capacity would be needed to justify mining above this on a large scale because there is no site below the Narrows at which further impounding could be done.

---

*Telephone communication from Mr. A. L. Wisker, Jan. 25, 1927.

Fortunately a very large capacity is obtainable there. In addition there is great advantage because of the large flow of water, the flow of the Middle and South Yubas being increased by that of the North Yuba and the combined flow of the three will enable about 17,000 horsepower to be developed. Water may also be distributed to a large area of agricultural land from this point of vantage. Therefore, the purchase of debris capacity in a dam at the Narrows is the rational solution of the debris question for the South and Middle Yubas, for, by combining the three purposes of this dam it is possible to secure debris storage cheap enough to work low grade gravels. The proposal is embodied in the letter printed on page 35.

Space Left at End of 20 Years.

It will be noticed that the capacities of the dams recommended approximately equal the amount of debris expected to be produced in 20 years, except in the "Narrows" dam which would provide capacity for over 40 years at the estimated rate of work. In each case the debris impounding capacity is calculated with an allowance for debris lying in the cañon behind the lake of quiet water and rising at the rate of 15 feet to the mile. If the debris is retained in cañons at a different slope from this, the allowance may be changed, but in the meantime it is all that the engineers of the Debris Commission feel justified in making. When a fan-shaped deposit of debris forms at the head of a lake, the water coming down the slope will spread out over the surface and thereby lose much of its power of transporting debris. This will give a greater slope. A greater slope would very considerably augment the debris restraining capacity of each dam and lower the cost of impounding so that at the end of 20 years there may still be capacity for more debris and the water would be properly cleared before it overflows. This has been duly considered when adopting the allowance of a slope of 15 feet to the mile.

The yardage of debris that can be impounded by a dam would be the water impounding capacity plus the cubical contents of a prism bounded on the bottom by the plane of the water surface and on top by that of a surface graded back from the dam crest at a slope of 15 feet to the mile. The sides of the prism would be the sides of the cañon, and the contours of these were surveyed to enable calculations of this sort to be made.

SETTLEMENT BEHIND THE DAMS AND TURBIDITY OF THE OVERFLOW.

The settlement behind the dam and consequent relative clearness of overflow is a matter of strong interest because of the benefit to the river channels below, particularly the navigable channels. The flood flow in each stream was calculated by taking the highest flow recorded in Bulletin No. 5.*

Table III. shows that when the river reaches the headwaters of the lakes behind the dams, the velocity of flow will be reduced to such a low point that the load of debris will be dropped in the still water.

---

*Flow in California Streams, being Appendix A to Report to the Legislature of 1923 on the Water Resources of California (see Table 175).

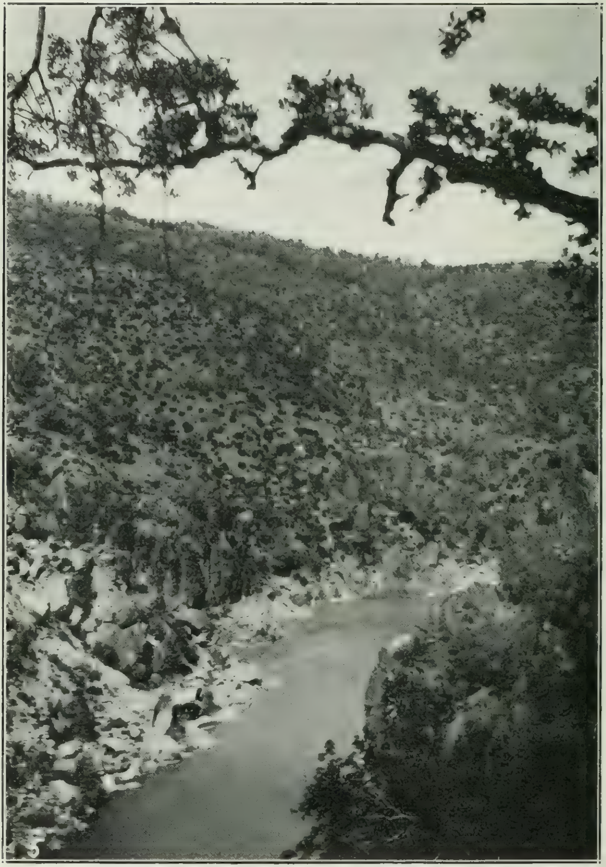


Photo by Arthur Jarman.

THE "NARROWS" ON THE MAIN YUBA.

View looking upstream from the site of the proposed dam to be erected by the Yuba River Power Company. This will afford storage for 40 years of hydraulic mining on the South and Middle Forks and Main Yuba River. Approximately 17,000 horsepower can be developed here by a dam of the height proposed, 220 feet. This will impound 72,000 acre-feet of water.

Even the 'slickens' will settle because the velocities in the worst floods will only be from one-fifth to one-half foot per second.

The flow for the particular river branch was found by distributing the entire flood flow between the branches in proportion to the drainage area served by each.

At the position of maximum cross-sectional area of the lake impounded by the dam we shall have minimum velocity of current and therefore the best settlement.

Considering the flood flow passing this cross-section we obtain the velocity. It may be objected that the current does not distribute itself evenly and that there is greater velocity at the center of the channel than at the sides and bottom. The reply to this contention is that this flood flow velocity was applied to and used for times of average flow so that we have a large factor of safety. The velocities for minimum flow are not given. They would be very much lower.

At times of minimum flow the water normally in the river will be supplemented by that released from storage for use in the mines. It is at these times of small flow that turbidity will be at a maximum and not at flood time, the reason being that the proportion of debris to water will be at its highest. On some rivers there is only a small amount of unappropriated water left in the stream during the summer, and in all cases there are several summer months when 'piping' stops for lack of water. During these months the miners occupy themselves with the deepening of rock-cuts, extensions of tunnels, and driving drifts and cross-cuts for the placing of powder blasts to bring down the cemented gravel.

TABLE III.

Velocities of Water in Dams at Crest of Maximum Flood.

Dam	River	Flow in second-feet	Height of dam (feet)	Cross-sectional area in square feet	Velocity at crest of worst flood
Nortons	South Yuba	32,500	270	74,500	.38 feet per sec.
Jones Bar	South Yuba	32,500	220	61,300	.53
Freemans	Middle Yuba	20,000	225	170,000	.105
			125	57,200	.35
Owl Creek	North American	34,200	190	118,150	.29
Narrows	Main Yuba	111,000	220	600,000	.19
	Ordinary flood on Main Yuba	50,000	220	600,000	.09

The "Narrows" dam on the Main Yuba will restrain debris from large scale operations at Columbia Hill, Bloomfield and Omega, and it is important to notice that the velocity at times of worst flood recorded would be reduced to .19 foot per second at the widest portion of the lake. Ordinary floods for 29 years out of 30 do not exceed 50,000 second-feet flow and on these occasions the velocity would be reduced to .09 foot per second. Therefore settlement will be efficient even with operations proceeding on a large scale.

The Sacramento River at Sacramento at all times has a velocity 5 to 10 times greater than would be found in any of these dams and the turbidity found there results from that velocity.

Having calculated the flow in the dam lakes it is evident that any particles that remain in suspension would be so minute as to be microscopic and the water passing over the crest of the dam would be clear or at the worst only faintly cloudy. This clear water would benefit the navigable river channels by scouring them.

Fine sand that passes a 200 mesh sieve (having 40,000 apertures per square inch) settles readily at the low velocities given in this table. Any matter that remained in suspension would be fine colloidal material or clay that was worked with the gravel. This might discolor the water slightly but the sand and gravel that rolls down the rivers during winter rains would be permanently retained by the dams, thus benefiting the river channels below.

Photo by Ernest A. Bailey,
Flood Engineer, Sacramento.

DEPOT HILL MINE (Joubert's).

Operating on the North Fork of the Yuba River above the Bullard's Bar Dam. March 4, 1926.

Prominence should be given to the fact that all surface soil and clay has been removed by former operations at Gold Run and Dutch Flat, also from much of the ground at You Bet and Little York, and for almost the whole of the enormous area available at Columbia Hill (or North Columbia). This very materially reduces the problem of settlement of mud from the water after use. After injunctions were obtained and mines were obliged to impound the debris caused by hydraulicking, further trouble was caused by the extreme turbidity of water and the **large amounts of actual debris in water that flowed from dams;** this eventually resulted in the tight shutdown of hydraulic mines. The miners were to blame in allowing debris to flow past the dams and **deliberately causing it so to do.** This is now a matter of history, but it explains the strong feelings of the farmers and accounts for their employing agents or 'spies' to report such matters.

Since 1897 the Debris Commission has generally required dams to be of masonry or concrete construction in flowing streams to obviate failure and to prevent tampering with the structure. The success of such structures for the settlement of fine materials is seen at Bullards Bar on the North Yuba River. In April, 1926, when I visited this dam there had been good rains and a depth of nine-tenths of a foot of water was overflowing the crest from end to end (see Frontispiece), the total flow through the lake being 1700 second-feet, yet the water was so clear that not the slightest cloudliness could be detected by eye, i.e., the suspended matter was below one part in 10,000,000. Clays from natural denudation and from small hydraulic operations had settled completely.

THE RESTRAINING OF NATURAL DEBRIS AND VALUE FOR FLOOD CONTROL.

Mr. Ernest A. Bailey, engineer for Flood Control, Sacramento, has taken great interest in the relations of this hydraulic work to that of flood control in the Sacramento Valley, and I have had the pleasure of visiting most of the flood control works in his company. These flood control works represent a considerable capital expenditure and it is well to emphasize the fact that the clear water from the proposed dams will increase the scour of the river channels and in this way assist in reducing the flood menace in the Sacramento Valley.

Rivers flowing through mountain districts have steep gradients and therefore a high carrying power. They have beautifully clear water in the summer months of small flow because the winter freshets have carried away all the light material that causes turbidity. In winter they have heavy loads of sand and gravel and are turbid with clay and soil washed from the hillsides. This material is carried down to the quiet stretches of river where most of it is deposited and is later removed by dredging. The finest particles remain in suspension and pass down to the harbor.

Very little data is available on the subject of turbidity of the rivers mentioned in this report. A few samples were taken from the surface of these streams and they showed considerable sand during winter months. Gravel also rolls down the bed of the stream but this can not very well be measured. It is known to move downstream during winter floods because pools become cleared from gravel that is dumped into them. Debris dams will prevent this natural debris from travelling downstream and will thereby benefit the channels below. The clear water that overflows the dams will assist by scouring the channels of the rivers below, and in this way materially assist in reducing the danger from floods. The dams proposed are not large enough to be used for flood control, but the combined effect of storage of water for use above the mines and restorage below them in the debris dams will operate in the direction of reducing the peaks of floods.

Sediment in Some Samples from Rivers Dealt With in This Report.

River	Locality	Date	Sediment in parts per 1,000,000 by weight	State of the river
South Yuba	Edward's Bridge	Apr. 9, 1926	103	Fine weather and good flow of clear water
South Yuba	Washington	Jan. 2, 1927	1,560	Raising river, freshet, water very turbid.
Wolf Creek	Above Junction	Apr. 8, 1926	238	Creek in flood—raining.
Bear River	Gautier Bridge	Apr. 8, 1926	1,080	Big Flood—raining.
Willow Creek	Garden Valley	July 2, 1926	510	
Pine Grove	Jacksons	Mar. 10, 1926	90	
Sacramento	S. P. Bridge	Apr. 10, 1926	32	High water, flood subsiding on American River, but at its highest on the Feather.
Sacramento	S. P. Bridge	Dec. 10, 1926	96	High water, a few days after the levees were in danger at Colusa.
North Yuba	Bullards Bar Dam	Apr. 2, 1926	less than .1	Perfectly clear; not even a faint cloudiness; 1700 second-feet or 68,000 miner's inches overflowing the crest of the dam.

THE POWER DEVELOPABLE.

Calculations were made based on the figures for drainage area and seasonal run-off and distribution of run-off as given in Bulletin No. 5, 'Flow in California Streams,' by Paul Bailey. The results are only approximate because water is drawn off by various ditches and some of it is not returned to the stream. Daily gaugings would be needed for a long period to determine the water power available at each dam site. Nevertheless the figures obtained indicate what may be done in this way.

Provision should be made at each dam for the utilization of water power and to enable stored water to be drawn off to assist in irrigation in times of low water.

Use of Stored Water.

In dry months when the hydraulic mines have stopped piping, the water behind each dam would be valuable to farmers in country below. At these times the water may be released without affecting the work of the mines and any revenue derived therefrom would accrue to the state.

North Fork of the American River.

For four months the flow is below 3.6 per centum of the total and for three months it is less than 1 per centum. Assuming 150 feet of fall at the proposed dam, the average year will give 600 horsepower for twelve months without drawing on storage and 1200 horsepower for nine months. In the driest year recorded it would give 1200 horsepower for eight months using a dam of the size contemplated.

Middle Fork of the American River.

This dam would only give a fall of 45 feet and the fall would give 360 horsepower for the whole of the average year and 1000 horsepower for nine months. In the driest year recorded it would give 650 horsepower for more than eight months.

Lower Bear River Dam Site.

A dam with a crest 143 feet above low water would benefit the Pacific Gas and Electric Company's Bear River Canal leading to the

Halsey Power House by submerging a portion of it and supplying water free from sediment, at the same time allowing water to be drawn from storage in dry months. It would not have value as a power producer, because almost all the water is used already for this purpose being drawn off by the above mentioned canal.

Conclusion.

The value of the power developable at these dams is small because the dams are small and do not give enough fall, nor do they give enough water storage for running in dry months. It is probable that larger dams on the North Fork and Middle Fork of the American River would develop power that would pay and if so, the lower portion of the dam would serve to impound debris without detriment to the power feature of the plan. This would give opportunity for cheaper storage. Private investigations of the possibilities of power development have not proceeded far enough to enable negotiations for debris storage to be considered. Hydraulic mining and the development of power are not antagonistic. One is supplemental and helpful to the other and the development of a water storage system to give considerable pressure head for 'piping' naturally leads to this system being used for hydroelectric purposes when mining ceases. The stoppage of hydraulic mining led to the transfer of many of the water systems to power companies.*

If hydraulic mines are revived by the provision of storage dams they will renovate and enlarge their water systems which at the close of all mining will naturally become useful for hydroelectric power production and irrigation. In the latter cases the charges for service are subject to strict regulation by the State Railroad Commission as such concerns are regarded as public servants. Hence, after mining ceases, the farming and general community will continue to benefit from the additional water supplies developed by mining.

As work progresses on the large gravel deposits at Gold Run and at Columbia Hill, it will be possible in each case to leave a hydraulic pit in such a position that it will have great value for water storage and power development. As the gravel approaches exhaustion and

---

*The power business in California had its beginning in the mining business. Miners pioneered the path of the hydroelectric engineers of today. Their methods of construction, the manner in which they moved heavy machinery and material into rocky, remote regions, their designs for flumes, dams, and ditches, their tangential water wheel, all left a lesson to be learned, and as the hydroelectric engineers of the new day read the record in the rocks the achievements of the sturdy men of the mountains took hold of them and inspired the vision that brought about the wonderful developments of the power industry that have made California the envy of the world. None know the story better than the P. G. & E. This company supplied more power to gold mines than all other companies in the State combined. Never an engineer goes over its system but he realizes its debt to the old miners. Ten of the company's twenty-eight water power plants were originally initiated to provide energy for mining operations. Nine of its plants were installed on canals dug to supply water for mines. Out of that same hunt for gold came ten of the company's reservoirs. Blindly, perhaps, but like a Titan, the old-time miner builded for the future. Tonight his reservoirs, feeding power plants on some Sierra slope, will light homes hundreds of miles away. Some of his canals, blasted out of the rocks in the old pack-train days of the '50's, still wind their rugged way through twenty miles and more of mountain in the great wheels that in a twinkling create the spark that spins a thousand factory wheels and makes goods, and work for multitudes, and cargoes for ships, and payrolls, and prosperity. It is a stirring tale, a tale too long to be told in a breath. It is a book, a book not yet written and too vast a work for the modest chronicler. The miner made California, and it is still his state, for the age of electricity has but sealed his title.—*California's Debt to the Miner, P. G. & E. Progress, Vol. I, No. 8, p. 2, July, 1924.*

the water power value increases, the latter may become a better source of revenue than mining for gold. On the other hand the lack of new discoveries of large gold fields and the increasing use and actual destructive consumption of gold in the arts makes this unlikely for many years. It is more probable that the purchasing power of gold will increase owing to its scarcity than decrease owing to the utilization of paper instead of coins. The use of paper for currency has probably reached its maximum.

RELATION OF THIS PLAN TO THE PROPOSED STATE PLAN OF WATER CONSERVATION.

State Engineer Paul Bailey called attention to the comprehensive scheme that his department is evolving to conserve and utilize to the best advantage the waters of the state. Several bulletins* of valuable information have already been published in connection with that inquiry.

If the water conservation plan is adopted by the state, enormous reservoirs would be constructed which would be able to accommodate the expected volume of hydraulic mining debris without its occupying more than 5 to 10 per centum of the water capacity of the reservoirs that are proposed. Two of these damsites are marked on the map, viz: those at Folsom and at the 'Narrows.'

It is to be hoped that this comprehensive plan for conserving the waters of the state will be adopted, or some modification of it, but the expenditure is large, and it may have to wait a time of education and campaigning before such expenditure will be sanctioned. In the meantime hydraulic debris dams can be built for a relatively small sum of money. These dams would supplement those proposed for water conservation and would in no way conflict with them.

---

*Bulletins Nos. 5, 6, 7, 8, 9 and 12.

GROWTH AND DECLINE OF HYDRAULIC MINING.

Hydraulic mining as defined by the state and federal acts "is mining by the means of the application of water, under pressure, through a nozzle, against a natural bank, thus eroding the bank." The mixture of gravel, sand, loam and water runs along rockcuts and sluices that eventually discharge on lower ground leading to streams that carry the material away. The sluices contain riffles to retain the gold that settles in them. Quicksilver is generally placed in the riffles to assist in catching the finer particles of gold.

This method of mining was invented in California in 1853. The first rigs conducted water from the ditch to the face of the gravel bank by wooden boxing and canvas hose. These were soon replaced by iron pipes which withstood considerable pressure, and after this improvement the gold obtained grew by leaps and bounds until the state became world famous for this class of mining. The scale of work reached enormous dimensions, the gravel washed by this process in 1880 being estimated as 46,025,391 cubic yards, which is equivalent to a piece of ground one mile long, one mile wide and 15 yards deep. All this was washed into the rivers in twelve months. No wonder the hydraulic miner soon had trouble on his hands. Such an enormous scale of hydraulicking has never been approached in any other country.*

Mr. Waldemar Lindgren, in his classical memoir on the Gravels of California[1] reviewed the estimate made by Gilbert[2] and by the State Engineer and by engineers of the Debris Commission, and he concluded (p. 21) that the nearest approach to a measure of the gravels that had been washed into tributaries of the Sacramento River alone was 1,295,000,000 cubic yards. Most of this was washed prior to injunctions such as the famous decision by Judge Sawyer in 1884. The rate of work quoted for the year 1880 was estimated in a report presented to Congress in 1882, by Lieut. Col. G. H. Mendell.[3]

The water used in the Sacramento Basin was obtained from the returns of the county assessors, and this information was supplemented by further information from the State Engineer's Department. Knowing the water used and having some estimates of the amount of work that could be done by a 'miner's inch' of water as determined by surveys and measurements, it was calculated that the total yardage moved in the Sacramento Basin in 1880 was 38,610,926 cubic yards. Similar information concerning rivers south of the American gave a total of 7,414,465 cubic yards, so that the total for the northern half of the Grand Valley was 46,025,391 cubic yards.

---

* For a more detailed history of this trouble and its consequences, see pages 146 to 152 of a report entitled SACRAMENTO FLOOD CONTROL PROJECT, revised plans submitted to the Reclamation Board by W. F. McClure, State Engineer, February 10, 1925, (issued 1927).

[1] The Tertiary Gravels of the Sierra Nevada of California, by Waldemar Lindgren, being professional paper No. 73 of the United States Geological Survey.

[2] Hydraulic Mining Debris in the Sierra Nevadas, by Grove Karl Gilbert, being professional paper No. 105 of the United States Geological Survey.

[3] Mining Debris in California Rivers, Ex. Doc. No. 98, 47th Congress, 1st session.

This is shown in the following table which is compiled from tables given in Lieut. Col. Mendell's report (pp. 15 and 16):

River	Water used, miner-inch-days	Duty, cubic yards per M.I.D.	Gravel moved cubic yards
Table Mountain or Dry Creek	833,250	3½	2,916,375
Butte Creek	24,000	3	84,000
Feather River	1,259,363	3½	4,407,770
Yuba River	5,458,171	3½	19,103,598
Bear River	1,117,082	3	3,351,246
Dry Creek No. 2	44,229	3	132,687
American River	1,914,500	4½	8,615,250
Totals	10,650,595		38,610,926
Rivers south of the American	3,384,370		7,414,465
Grand totals	14,034,965		46,025,391

The deposits on the Feather River are dispersed over a large area, but those on the Yuba, Bear and American rivers are closer together, making a district that was one of considerable activity. All the material in the upper part of the table was eventually discharged into the Sacramento River and its tributaries above the capital city.

The immense scale of these operations caused serious silting of the river channels and partial blockage of streams tributary to them, so that in flood times much damage was done to farm lands adjacent to the rivers. In consequence there were many actions at law in the state courts which resulted in injunctions against the mines. Immediately prior to the general closing of hydraulic mining the annual yield is estimated to have been reduced to $5,300,000.[1]

Finally the decree of Judge Sawyer of the United States Circuit Court restrained the North Bloomfield Mining Company from discharging debris into the streams. This was in 1884. The court reserved the power to modify or suspend the injunction upon the defendant's showing that conditions had been so changed that the discharge of debris may be conducted so as not to continue the nuisance complained of. That is to say, hydraulic mining was not declared to be illegal, but the discharge of debris into the streams was forbidden. The provision of a dam to restrain the debris might make the necessary change in conditions to allow mining to be resumed.

Mine after mine was closed by injunction based upon this decision, and the federal legislation passed in 1893 (the California Debris Commission Act, or Caminetti Act) embodied the principles declared by these injunctions, but enacted more severe penalties for their nonobservance.

Present State of the Law.

The present state of the law is that hydraulic mining is illegal if carried on in such manner that it injures the navigable river channels of the Sacramento or San Joaquin river systems or the lands adjacent thereto; that the efficiency of a dam for restraining debris so that it shall not reach these channels is subject to approval by the Debris Commission, and a permit from that body is necessary before mining may be started.

---

[1] See Chas. S. Haley, "The Gold Placers of California." Bulletin No. 92, California State Mining Bureau, 1923, p. 16.

Gold Production and the Effects of Litigation and Legislation.

How much gold was obtained from hydraulic operations is not known, as the statistics that are available do not segregate the gold according to origin or method of production until the year 1897. Much gold was never reported and considerable sums may have been exported without being included in returns given by the mints, smelters, or express companies, to whom we are indebted for the only statistics of early years that are available.*

Lieut. Col. Mendell in his report of 1882 (Ex. Doc. 98) already quoted, gives a very complete account (pp. 22, 23) of all data that was available, and shows that from 1848 to December, 1881, the value of the known total production of gold from all sources in California was $1,178,000,000. Mr. Waldemar Lindgren in Professional Paper No. 73, already quoted, states (p. 81) that the production up to the end of 1909 amounted to between $1,200,000,000 and $1,500,000,000.

Of this amount he considers that one-fifth came from quartz veins and the bulk of the remainder was from river gravels that were very rich and easily washed. The gravels that were higher in elevation and required hydraulic methods to treat them, and which geologists speak of as the tertiary gravels, he considers produced up to the end of 1909 about $300,000,000. A reliable estimate cannot be made for lack of data, and Mr. Lindgren calls this figure of his a "conservative guess." The gold production from all sources for 1880 (including the silver value that it contained) was $18,276,166,[1] according to Mendell's report.

Prof. J. D. Whitney in his Auriferous Gravels, written in 1879, says (p. 368): "The best authorities estimate the present yield from this source (hydraulic) at from $12,000,000 to $14,000,000,"[2] (per annum).

The Miners' Association estimated in 1881 that the annual gold production from hydraulic mining was between $11,000,000 and $13,000,000.

John Hays Hammond, writing in the IX Annual Report of the California State Mineralogist, 1899, said (p. 121): "The recent suppression of hydraulic mining by judicial decisions has reduced the annual gold product of California by at least $10,000,000 * * *"

The rapid fall in production from hydraulic mining after injunctions began to be issued has already been mentioned, and the present production averages only $122,114 (see p. 12).

---

* Years ago Wells, Fargo & Co. offered to the Mineral Resources Division of the U. S. Geological Survey all the receipts for gold bullion shipped through their agency from the beginning of gold mining in California. To work upon this mass of paper and produce therefrom a statement of yields from the individual mines would have required a staff of clerks for some months. Neither the Geological Survey nor the State Mineralogist office had funds to do this work and no prospect of obtaining funds for it. The papers were burned to get rid of them and thus perished much valuable data on the gold production of mines in California.

[1] Estimated by J. J. Valentine, Supt. Wells, Fargo & Co., see Mendell's Report, p. 23.

[2] Auriferous Gravels of the Sierras. Memoirs of the Museum of Comparative Zoology of Harvard; Contributions to American Geology, Vol. I, by J. D. Whitney.

Benefits That Were Intended for the Hydraulic Miner in the California Debris Commission Act.

The California Debris Commission Act was passed not only to protect farming lands and navigable rivers, but was also intended to assist hydraulic mining. The miners expected it to accomplish great things for them. It provided a nonpolitical body of army engineers whose duty it is to administer the act, survey the rivers for dam sites, erect dams when money was appropriated for them, and study and research "in divising a method or methods whereby such mining may be carried on as aforesaid" (Sec. 5).

To quote section 25 of this act in part:

> "Sec. 25. That said commission * * * is hereby directed and empowered, when appropriations are made therefor by law * * * to build at such points above the head of navigation * * * such restraining or impounding dams and settling reservoirs * * *."

The act further provides the rate of payment that shall be made for mining behind such restraining dams, the determination being made in a very simple and direct manner and at low cost to the miner. To quote section 23 in part:

> "Sec. 23. * * * the individual, company or corporation operating thereunder working any mine or mines by hydraulic process, the debris from which flows into or is in whole or in part restrained by such dams or other works erected by said commission, shall pay a tax of three per centum on the gross proceeds of his, their, or its mine so worked; * * *"

RESULT OF THE PRESENT INQUIRY.

Gravel Deposits That May Be Benefited.

Although no dams have been built by the Debris Commission as forecasted by this act, and although the production for 1925 was only $175,345 of which less than one-half was from the Grand Valley, there are some remarkably fine gravels that await the solution of the present difficulty—the provision of efficient debris impounding capacity at low cost.

In a report made to congress by the United States Corps of Engineers in 1891 (Ex. Doc. 267, p. 86) the gravel remaining in the Sacramento Basin and workable under the old conditions (*i.e.*, without restrictions as to dumping the debris) was estimated as 518,725,000 cubic yards; and a much larger amount if long tunnels and ditches were constructed to give access to ground not yet available—viz: 1,508,875,000 cubic yards, which is more than the amount already washed.

The restraining works at Daguerre Point were completed in 1910 but no moneys have been appropriated to enable the commission to build dams for the hydraulic miner. The matter has lain in abeyance in spite of official reports that such huge quantities of gravel are available, therefore this report deals only with those rivers where work formerly proceeded on the largest scale, and where water supplies are still available, viz: the Middle and South Yubas, Bear River, and the North and Middle American, all of which eventually discharge into the Sacramento River above Sacramento City. (See the map which accompanies this report and shows the locations of the gravels and of the various dams proposed.)

The most important reports already made to congress are Lieutenant-Colonel G. H. Mendell's reports of 1881 and 1882,* also the report of the Board of Engineers, made in 1891.**

The first two deal with conditions two or three years before injunctions were issued, and the last one reports conditions as they were six years afterwards. With these as a starting point the gravels have been visited, and conditions that affect them have been reviewed.

Preliminary investigations raised the hope that by utilizing these vitalizing provisions of the act, that is, by providing dams, hydraulic mining might be revived on the Yuba, Bear, and American rivers to an industry of considerable size.

Inspection of the more important gravels in these districts for the present Hydraulic Mining Commission showed that only 712,000,000 cubic yards could be regarded as workable under the changed conditions. A preliminary estimate of this amount was communicated to the Californa Debris Commission, February 15, 1926, and was as follows:

Preliminary Memorandum of Workable Hydraulic Gravels February 15, 1926, According to River Basins.

	Millions of cubic yards
North Fork American:	
Iowa Hill, Gold Run, Yankee Jim	115
Above Rice's Br. and N. Fork Br.	
Middle Fork American:	
Forest Hill, Michigan Bluff and Todd's Valley	30
Above Ruckachucky Canon.	
Bear River, with Greenhorn and Steep Hollow:	
Liberty Hill and Dutch Flat, Little York, You Bet, Red Dog, Chalk Bluff, Hunts Hill	43
Above Van Giesens and below Greenhorn Ck.	
South Yuba:	
Alpha, Omega, Sailor Flat, Blue Tent, Relief Hill.	
Above Edwards Br.	
N. Bloomfield, Malakoff, Lake City, N. Columbia, Esperence, Fr. Corral	415
Above Edwards Br. or Jones Ravine.	
Catch fines at Narrows.	
Middle Yuba:	
N. San Juan, Birchville, Badger Hill, Cherokee, Moores Flat	109
Above Emory Ford, Freemans Br. & Narrows.	
Total	712

This is a preliminary statement of gravel in place which can be handled by hydraulic mining, having sufficient grade and not being capped heavily by volcanic material.

ARTHUR JARMAN.

February 15, 1926.
For Mr. Egenhoff, California Debris Commission.

To mine this gravel it was recommended that dams would be required on the Middle and South Yubas, the Bear, and the Middle and North American rivers, in positions to be chosen from those shown on the accompanying map. Data on some of these sites were already available and the California Debris Commission sent their survey parties in the field to survey others. The results of this work have already been recorded.

---

*Known as Ex. Doc. No. 76, 46th Congress, 3rd Session, 1881, and Ex. Doc. No. 98, 47th Congress, 1st Session, 1882.

**Known as Ex. Doc. No. 267, 51st Congress, 2nd Session, by Lieut. Col. W. H. H. Benyaurd, Major, Thos. H. Handbury, and Major H. H. Heuer.

Estimation of Probable Rate of Working.

Totals for 20 years are given in Table I compiled from the estimated rate of working of the principal gravels on each river, the data being given at the end of the report for each river in turn. The yardage workable at each mine is calculated from the water available. Any increase in water supplies would increase the production beyond that given in the tables.

The rate at which gravel can be mined depends chiefly upon volume of water that can be run over the broken bank of gravel to carry it into the rockcuts and along the sluiceboxes. Good grade in rockcuts and sluiceboxes is more important for output than pressure at the nozzle, because it is the amount of material that can be transported out of the pit and down the sluiceboxes that actually determines the volume that can be mined. A bank of gravel can be broken down more rapidly than the gravel can be washed down the sluiceboxes. Cemented gravel can be shaken to pieces by the judicious use of powder when breaking down the bank, and moderate water pressure will give sufficient impetus to the jets to carry gravel into the cuts.

Justification of a Dam for Each River in Turn.

Considering each river separately we have at least one large gravel deposit which if proven to be profitable under the proposed conditions of resuscitation would by itself justify the erection of a dam so large that it would also serve other mines on that river. Judged in this way we may say that a dam that would serve the principal deposit for 20 years would serve all deposits on that river for 15 years, or something of this order, each case having to be worked out according to the deposits and the conditions.

This method of treatment has been followed, the 'key' deposit on each river receiving most attention. It has been impossible to obtain data required for the smaller mines or portions of gravels to enable reasonably close estimates to be made, but approximate yardages were calculated for ground favorably situated so that no mechanical difficulties would prevent it from being worked. The ground considered to be payable has been restricted to ground that would be readily worked.

(COPY)

THE YUBA RIVER POWER COMPANY
725 Standard Oil Building, San Francisco, California.
January 29, 1927.

Hydraulic Mining Commission,
Ferry Building,
San Francisco, California.

Attention Mr. Arthur Jarman, Secretary.

Gentlemen:

The Yuba River Power Company is the owner of a comprehensive project for the development of the water resources of the Yuba River in the joint interests of the power, agricultural and hydraulic mining industries. This project comprises a series of power plants and reservoirs along the Yuba River and its North and Middle forks. The Bullards Bar unit was the first unit contracted under this project. The Yuba River Power Company has purchased certain lands for its various units, and the Federal Government has withdrawn in aid of the project the Federal lands necessary. This company also has applications before the Federal Power Commission and the Division of Water Rights of the State of California for the water and power rights pertaining to the additional units in the complete project.

Your Commission is interested in that phase of our development program covering the storage of debris from the operation of hydraulic mines. The construction of the Bullards Bar Dam has provided storage space for debris on the watershed of the North Fork of the Yuba River. Therefore, so far as the Yuba is concerned, it is now necessary to deal only with the South and Middle forks. This problem can be solved by the construction of The Yuba River Power Company's unit at the Narrows, near Smartsville, on the main river.

At present, our preliminary cost estimates on the Narrows unit have been made without actually drilling the dam site, nor have final figures been worked out as to revenues from power and irrigation and debris storage space, but preliminary estimates indicate that we can sell outright the 350,000,000 cubic yards of debris storage space for $1,500,000. This quantity is the actual cubical contents of debris storage space estimated to be available at the Narrows unit with a dam having its crest at elevation 520 feet above mean sea level.

In the meanwhile we will place at the disposal of the Hydraulic Mining Commission and the California Debris Commission, all data which is in our possession, and cooperate in every way and offer all facilities for such further investigation of this subject as are considered necessary. We consider it only fair that in return, any engineering data required by either of the Commissions should be made available to all parties concerned.

Very truly yours,

THE YUBA RIVER POWER COMPANY.
R.E.P:R. (Signed) By R. E. PHELAN, President.
Copy to California Debris Commission.

Address Reply to
Secretary, California
Debris Commission,
85 Second St.

(COPY)

WAR DEPARTMENT

California Debris Commission,

San Francisco, California.

Refer to File No. 26761.

Subject: Preliminary estimates of proposed debris dams.

Mr. Lloyd L. Root,
State Mineralogist,
Ferry Building,
San Francisco, Calif.

Dear Sir:

Inclosed please find statement you have requested for the information of the California Hydraulic Mining Commission.

FOR THE CALIFORNIA DEBRIS COMMISSION:

Very truly yours,

(Signed) C. S. RIDLEY,
Major, Corps of Engineers,
Member and Secretary.

1 Incl.
(statement)

Estimates.

Following are preliminary estimates made up from data available at this time. The storage estimates are based on those considered necessary or desirable for 20 and 10 year periods of mining operations respectively and the assumption is made that the debris will stand on an average slope of 15 feet to the mile.

Twenty Year Period.

River	*Site*	*Storage, cu. yds.*	*Cost*
Middle Yuba	Freemans	51,000,000	$1,150,000
South Yuba	Nortons	70,000,000	3,090,000
South Yuba	Jones Bar	20,000,000	745,000
Bear	Lower Bear	21,000,000	310,000
North Fork American	Owl Creek	41,000,000	935,000
Middle Fork American	Mammoth Bar	22,000,000	125,000
Totals		225,000,000	$6,355,000

Ten Year Period.

River	*Site*	*Storage, cu. yds.*	*Cost*
Middle Yuba	Freemans	26,000,000	$545,000
South Yuba	Nortons	35,000,000	1,450,000
South Yuba	Jones Bar	13,000,000	420,000
Bear	Lower Bear	11,000,000	195,000
North Fork American	Owl Creek	21,000,000	470,000
Middle Fork American	Mammoth Bar	11,000,000	100,000
Totals		117,000,000	$3,180,000

The estimates for Freemans, Nortons, and Jones Bar sites are based on surveys made under direction of the California Debris Commission during the past year and are complete except that no subsurface exploration has been made of the dam sites. The estimate for the Lower Bear site is based on a combination of three surveys: One by U. S. Geological Survey in cooperation with the State of California, one by the California Debris Commission in 1905, and one by the California Debris Commission in 1924–25. It is believed to be reasonably close for preliminary estimates, but if construction work is contemplated, further check surveys should be made. No subsurface exploration was made at the dam site. The estimates for the Owl Creek site are based so far as the reservoir is concerned on data collected during the past year under the direction of the California Debris Commission. The reservoir site was taken from a private survey. No subsurface exploration was made at the dam site. The estimates for the Mammoth Bar site are based on two surveys: One of the area covered by the reservoir made in 1912 by the U. S. Geological Survey in cooperation with the California State Water Commission and published on a scale of 2 inches equals 1 mile; and the other of the reservoir site on a sketch map made under direction of Major W. H. Heuer. The nature of these data of course makes the above estimate of cost for this site only a rough approximation and if construction work is contemplated additional surveys are necessary. No subsurface exploration has been made at the dam site.

It will be noted therefore that borings are required at all of the dam sites before final estimates can be made or indeed before final decision can be made as to the practicability of dam construction at these sites. In addition to this further surveys are needed at the Lower Bear and Mammoth Bar sites.

GRAVELS OF THE NORTH FORK OF AMERICAN RIVER.

Estimates of Gravels on North Fork of American River—Quantities in Millions of Cubic Yards.

Name of report	Whitney	Mendell	Board of Engineers	U. S. G. S.	This report
Engineer	(Pettee)	(Larson) Ex. Doc. No. 98	(Turner) Ex. Doc. No. 267	(Lindgren) Prof. Paper 73	(Jarman)
Year made	1879	1881	1891	1911	1926
Gold Run	86 to 125	18.48 1.21 on 95 acres only	46.0 on 555 acres	92	75
Iowa Hill—proper	23 to 24	6.38	28 7 to 30.0	----------	8
Bird's Flat		7.26		----------	
Momona Flat		4.06		----------	
Roach Hill and Independence Hill		1.62		----------	
Wisconsin Hill	----------	5.08	----------	----------	Over 12
Gleason	----------	----------	----------	----------	
Big Dipper	----------	----------	----------	----------	
Forest Hill—North Side	No estimate	19.36	----------	No estimate	*
Mayflower			12.0	No estimate	
Smith's Point			5.8	No estimate	
Georgia Hill			0.5	No estimate	
Lost Camp (Blue Canon)					10 claimed
Totals	109 to 149	63.45	93.0 to 94.3	----------	Over 95

*Doubtful whether this would be worked.

Rate of Work Expected on North Fork of the American River and Production for First Twenty Years.

Mine or district	M.I.D. available	Duty	Per annum		For first twenty years	
			Yardage	Yield	Yardage	Yield
Iowa Hill	150,000	4	600,000	$42,000	12,000,000	$840,000
Gleason						
Big Dipper						
Gold Run	250,000	2	500,000	70,000 to 95,000	10,000,000	1,650,000
Forest Hill	----------	----------	Doubtful if these would be worked			
Lost Camp Mine at Blue Canon	*	----------	50,000	7,500	1,000,000	150,000
Park and Brown Mine	----------	----------				
Totals	400,000	----------	1,150,000	$119,500 to $144,500	23,000,000	$2,640,000
Average per annum	----------	----------	----------	$132,000	----------	----------

*Purchased, quantity variable.

In 1880 the total water used on the three forks of the American River was 1,914,500 M.I.D., with a duty of 4½; this gave an annual yardage of 8,615,260. The duty would be lower than 4½ because the gravel at Gold Run is middle and bottom gravel, all top stuff having been removed

GOLD RUN.

North Fork of the American River.

The Gold Run gravels are the key to the case for the North American River. The deposit extends from Indiana Hill on the south to Dutch Flat on the north, a distance of four miles. The width of the gravel varies from 600 to 1000 yards and averages over one-half mile. More than half of this ground is on the south side of the ridge along which runs the railroad. Most of this is under one ownership, having been consolidated in 1911, and would be economically worked in consequence. It is on the south or American River side of the ridge that separates the North Fork American from the Bear River. The length of channel is 4053 yards; this has an area of 1,401,180 square yards leaving out of account gravel too far to one side or too high on rims to be worth while attacking.

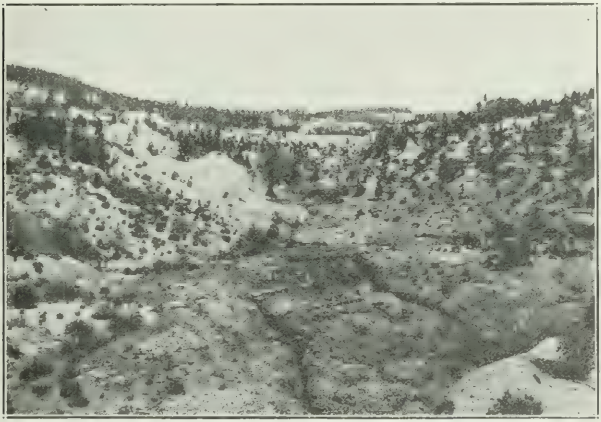


Photo by Ernest A. Bailey,
Flood Engineer, Sacramento.

STEWART GRAVEL MINE AT GOLD RUN.

View looking north, showing the pit of the mine with the slate bedrock exposed and the rock cuts in it. The extension of this pit by future hydraulic work will create a reservoir useful for water conservation and the development of power. Debris will be restrained by a dam on the North Fork of American River.

Starting at the south end of this ground, at Indiana Hill, the bedrock has been washed clean for about 330 yards along the channel, then there is a body of bottom gravel 40 to 60 yards deep occupying the channel for 220 yards this has been tunneled and drifted. Immediately north of this gravel is the old Indiana Hill pit; the bedrock here was washed clean for 550 yards along the channel and for a width of 700 yards. In both pits the bedrock slate is very gently dished, being the floor of a glacier. Banks of gravel were left on the sides or rims of this channel and under them the rock rises sharply. At the north end of Indiana Hill pit the gravel has been drifted; the main tunnel was driven 553 yards along the channel, most of it at a few feet above bedrock. This makes 1633 yards of channel explored by drifting or exposed by hydraulicking.

Up to this place on the channel the amount of gravel is calculable and is 27,436,000 cubic yards, the depth of gravel being known from surface survey and from the known bedrock positions. It is 2420 yards from this point to the railroad or north end; the gravel surface is known but bedrock is not exposed again until Dutch Flat is reached, when it is found to have risen about 100 feet in 4 miles of channel. There are no surface indications of faulting. This section of gravel therefore has bedrock with a grade of about 25 feet per mile and similar to that exposed by workings in the south end as already described. As the gravel is wider here, it is expected that the bedrock will be flatter than before, as is usual in these gravels of the Sierra. Knowing the elevation of the gravel surface and deducing the position of the bedrock in this manner, we have depths of gravel in the center of the channel from 66 to 80 yards.*

As these depths are applied to calculate the yardage for a considerable length of channel (2420 yards) and an area of 895,400 square yards, I have assumed as a factor of safety that the bedrock is dished or curved instead of almost flat.

If the bedrock were horizontal right across, the cross-section would be rectangular and we should have 62,672,000 cubic yards but with the channel of curved cross-section we obtain about 47,500,000. Add this to our previous figure of 27,436,000 and we have the total of approximately 75,000,000 cubic yards as the gravel available and workable if gold contents are satisfactory.

The Table on page 41 gives other estimates for the purpose of comparison.

Values in the Gold Run Gravels.

In the absence of sampling by prospecting shafts or other openings in the unworked gravels, it is necessary to use what past records are available. Unfortunately these are only of a fragmentary nature due to the fact that Mr. Jas. D. Stewart's library and papers were burned when his residence was destroyed by fire at Auburn, in 1916.

The top gravel washed in early times has gone, being washed off along the whole length of the channel except for the narrow strip under the railroad and highway, and some rim gravel out on the sides, that is not included in this estimate.

The old accounts of this top gravel must be considered as they are apt to be quoted, though they do not represent the deeper gravel that remains.

Whitney, p. 147, records the following estimate made by W. H. Pettee in 1879. Between the railway and the southern end an area of 427 acres had been worked and his measurements showed 43,000,000 cubic yards were washed off. Returns from the banking house of Messrs. Moore and Miner at Gold Run, from March, 1865, to October, 1870, showed bullion shipped $1,385,280.55. Much gold was known to be shipped by other routes and he ssumed $615,000 of gold sold elsewhere, giving a total of $2,000,000 approximately, which gives a value of 4.65 cents per cubic yard. This was mostly top gravel.

---

*These depths were ascertained by Mr. J. D. Stewart by surveys.

He remarks that this amount of gold per cubic yard falls much below the estimates of miners and claim owners.

E. Call Brown, consulting engineer of Los Angeles, reports that between 1856 and 1882, five properties in this district bought an aggregate of 10,000 miner's inches of water per day at 50 cents per 24-hour inch*

Ross E. Brown,** in 1867 reports that these mines paid $1,000 per day for 9000 miner's inches (or 11 cents per miner's inch). Raymond, in the same series, 1875, p. 102, says the water rates in this district are 12½ cents per inch per 24 hours. It does not seem likely that old time miners were washing 5-cent gravel with such expensive water, even though the surface gravel at Gold Run had the reputation of being very easy to wash.

Waldemar Lindgren (Prof. Paper No. 73, p. 45) says "the yield per cubic yard of hydraulic gravel is said to be 11 cents." Lindgren is cautious in all his statements, and though he gives this value in a tentative manner, he does not even mention the lower figures given by Pettee. It may be that this gravel, very close to surface, was low in value, as at Bloomfield and Columbia Hill or North Columbia. Lindgren says 84,000,000*** cubic yards had been washed away. This is 41,000,000 more than Pettee's estimate, so that the gravel then being washed would be deeper and richer.

Mr. Jas. D. Stewart worked at Gold Run as a youth and later acquired control of this property. His father was superintendent of Gold Run for years. He says that large quantities of gold were shipped direct to the mint or to Selby smelter to obtain full value for it.

The top gravel has been washed off this deposit for a depth of 40 to 80 yards, this latter being the height of the ridge of gravel left to carry the railroad and highway. Near this bank in 1905 and 1906 some twenty Chinese washed some fallen gravel. They paid $10,000 gold for the lease, also paid $5,400 for water to wash it and were well satisfied with the results obtained. From a consideration of the water used and its probably duty, Mr. Stewart estimated that this gravel yielded 20 cents per cubic yard.

Value of Undrifted Hydraulic Bottom Gravel (Cemented) at Gold Run.

The following is the account of a gold bar obtained from work in June and July, 1908, on a bank of gravel 80 feet high that had not been drifted. This is the only bulk sample that we have record of.

Date: August, 1908—Weight of bar 3257.91 oz. Value $64,564.81. Gold fineness 902.
Obtained from 15 head boxes and undercurrent. The lower boxes were not cleaned up.
Height of bank: 80 feet.
Water used: 2000 miner's inches at 450 feet head.
Duration of run: 60 days of 24 hours each.
35 men employed.

---

* I have not been able to find any direct confirmation of this statement.

** Resources of the United States West of the Rockies, 1867, p. 101.

*** This is probably a quotation of Turner's estimate (see the Table on page 41).

Powder used: 5500 kegs of 25 lbs. each.
Dynamite used: 7500 lbs. of 40%.
237,400 cubic yards of gravel washed by actual measurement of the bank by surveyor.
This is equal to 27.2 cents per cubic yard.
Duty of the miner's inch 1.98 cubic yards.

Value of Drift Gravel of Bottom Ground at Gold Run.

Drifting operations in 1906 gave values shown by the following table. Each car held about 16 cubic feet of gravel which would be equivalent to about 27 cubic feet or one cubic yard of gravel in place, as the boulders were stacked behind in the working places.

Date	Quantity	Production	Dollars per cubic yard	Remarks
Apr., 1906	301 cars	$1,595 81	$5 30	Drifting above bedrock.
May, 1996	207 cars	504 00	2 43	Going north.
June, 1906	129 cars	120 50	0 94	
Oct., 1906	392 cars	1,590 71	4 06	
Nov., 1906	472 cars	1,933 00	4 10	Half of this was on bedrock.
Jan., 1907	122 cars	355 00	2 91	
Feb., 1907	165 cars	1,293 92	7 85	
Totals	1,788 cars	$7,392 94		

Average $4.13 per car or per cubic yard of gravel in place.

The above data enables us to obtain some idea of the value of the gravel hydraulicked immediately above the bottom drifting gravel. The drifts would be about 2 yards in height, so we calculate as follows:

Calculation:

80 yards of gravel at 27.2 cents	2176 cents
2 yards drifted at 413 cents	826 cents
78 yards hydraulic gravel would carry	1350 cents

This is at the rate of 17.3 cents per cubic yard.

From the 1600 foot tunnel 4375 cubic yards were taken that yielded $9,578.60 or $2.24 per cubic yard; over half of this material was two to seven feet above bedrock. This is from ground that will later be hydraulicked.

The following particulars are given by Mr. Stewart from his personal recollection or from notes: The Cement Mills Company mined 80,000 cubic yards of gravel by drifting under Indiana Hill at the south end of the property and it yielded $750,000 which is over $9 per cubic yard. The General Thomas Placer Mine on Indiana Hill produced $150,000 from 17,100 cubic yards of gravel mined by drifting; this is over $8 per cubic yard. These returns are interesting but they represent gravel at the south end of the property and therefore away from the direction of future work.

The Indiana Hill Placer Mine was one of over twenty that were working in the big pit mentioned on p. 42. Mint returns for three seasons show the following figures for this one mine:

1876	$ 24,091.68	
1877	19,636.35	
1878	93,784.96	
1879	14,712.91	—this last figure was for the January clean-up only.
Total	$152,225.90	

Value of Gravel Remaining to Be Hydraulicked.

Summarizing the foregoing statements: The first gravel washed was light surface material and Pettee estimated it at 4.65 cents per cubic yard; **this has all gone.** The next 40,000,000 cubic yards is reputed to have been 11-cent material as already quoted. The cemented gravel below this may be up to 80 feet thick and carry 17.3 cents per cubic yard, with drifting gravel below that carrying $2 to $4 per cubic yard, if it has not already been drifted.

Question: To what extent are we justified in applying these values to the gravel remaining? They apply to the 27,436,000 cubic yards remaining on the southern part of the property, that being where this hydraulic and drift work was done. This yardage at from 11 to 17 cents without counting undrifted bottom gravel that would raise the returns above 17 cents constitutes a very fine mine. Beyond this, at the northern end, work stopped for lack of grade, tunnels being required from Cañon Creek at the lower end to give grade. These tunnels are now available because of the consolidation of the properties into one, and would suffice to work a large area, but an additional tunnel would be required for the extreme north end. This north end, estimated to contain 47,600,000 cubic yards, should pay well under the new conditions as there has been no drifting done on it. The only way to tell whether there will be more or less gold than at the south end is to work it or put down trial shafts for sampling tests.

Storage is required and is justified for whatever amount can be worked in twenty years or the period considered. The first 27,000,000 should yield from 11 cents to 17 cents per cubic yard and the remainder should exceed these values as no drifting has been done in that area.

Water Available and Rate of Work Expected.

Upon this will depend the storage required for the first twenty years. The amount expected to be mined in other deposits on the same river must be considered also.

> 1600 miner's inches from Rattlesnake Ditch, giving 400 feet of pressure head.
>
> This flow is maintained for five to seven months, the water coming from Cañon Creek through 5 miles of ditch.

Total water for 5 months each of 26 piping days=1600x5x26=208,000 M. I. D.

Total water for 7 months each of 26 piping days=1600x7x26=291,200 M. I. D.

Average: 250,000 M. I. D. for the season.

To work this property to the best advantage a larger supply of water should be developed for a longer season.

The upper gravels at Gold Run gave high duty per miner's inch, the middle gravel is slightly cemented but crumbles readily when the bank falls or is shaken by powder blasts, and the bottom gravel is more strongly cemented. We, therefore, cannot use a high duty in calculating yardage expected to be moved.

The duty of 1.98 already recorded was from bottom gravel that was cemented and required crumbling by blasting. There is some bouldery material that would give a lower duty, but there is also medium gravel that would give a higher duty. An average of 2 may be expected and has been used for the purpose of this estimate; 250,000x2=500,000.

Gold Output Expected.

The bottom gravel that has been drifted would yield 17 cents and if undrifted, up to 27 cents.

The middle gravel would equal the general estimate of 11 cents, mentioned by Lindgren.

The mean of 11 and 17 is **14 cents** and the mean of 11 and 27 is **19 cents** and at these figures 500,000 cubic yards would produce from $70,000 to $95,000 for the season. Drifting has proceeded along the channel as described, but not always on bedrock, and breasting has not been carried right across the channel. The returns in undrifted ground may exceed 19 cents.

In 20 years 10,000,000 cubic yards could be worked with the present water supply and produce $1,400,000 to $1,900,000. In the table a mean figure of $1,650,000 has been used.

The development of additional water will enable this output to be exceeded without difficulty. There is plenty of gravel workable with the present tunnels.

Other Mines on the North Fork of American River.

Iowa Hill.

The ground upon which the town stands is a narrow ridge, the gravel having been washed away from it on both sides. It is unlikely that the houses at Iowa Hill would be removed to enable gravel to be worked as most of them are occupied.*

There are some banks of gravel left without lava cover, but in many places the work proceeded up to and under heavy thicknesses of barren volcanic material. These places would be unlikely to be profitable under present conditions.

At Independence Hill the face of the gravel bank on the north side shows a large trough that has been filled with andesite and tuffs. Roach Hill was worked until the cover of andesite was very thick. On the south bank of Indian Creek there is a succession of hydraulic pits that form an almost continuous coastline for a length of two miles. In some places these pits do not go far into the bank but at the Morning Star claim work was stopped by the thickness of the cover; drifting then proceeded for years and in 1899** connected with drifts from mines at Wisconsin Hill 3000 yards away. There, from pits of the Gleason, and the Waterhouse and Dorn or Big Dipper, a very large amount of gravel was removed, but a large amount of bottom gravel was left at the latter mine. These banks show a readily washed gravel, with no lava capping, there being over 12,000,000 cubic yards readily available in the immediate vicinity of the pits. As drifting operations have proved that this gravel passed through to the Morning Star side it should be workable with profit until the lava cover becomes too thick, and this figure may be exceeded. Previous returns show 5 to 7 cents per cubic yard but good profit was made because of the high duty per cubic yard.

---

* Many of these old mining towns were built upon good gravel, sometimes on the best part of it, right in the center of the channel: Iowa Hill, Little York, St. Louis, Wisconsin Hill, Michigan Bluff, Dutch Flat, Relief Hill, Omega, You Bet.

** Lindgren, p. 149.

In the table Iowa Hill and Wisconsin Hill together are credited with 20,000,000 cubic yards of workable gravel that should pay. If a dam be provided upon the North Fork American River at Owl Creek or some lower position these deposits would be worked because there is no large power or irrigation project using the water. Most of it is still available for mining.

Mr. I. E. Rose, part owner of the McGeachin Placer Mining Company (owning the Big Dipper Mine) surveyed this property in 1915 to determine the hydraulic gravel available. He estimated that 7,000,000 to 8,000,000 cubic yards had been washed away and 32,000,000 could be washed without trouble from overburden, and another 6,000,000 with overburden, making 38,000,000 in all. He estimated that it would contain 12 cents per cubic yard. The Gleason Mine adjoining it has had about 25,000,000 cubic yards washed away and would yield another 5,000,000. Previous operations here yielded about 15 cents per cubic yard.

In 1880 the mines at Iowa Hill used over 133,000 M. I. D. Very little water has been taken up for power and a larger amount could be developed for mining. The bottom gravel is partly cemented but would give a duty of 2, and the upper gravels a very much higher duty. In the IX Report of the California State Mineralogist, Mr. John Hays Hammond reported the duty obtained at the Hobson mine as 24 cubic yards per M. I. D. using 12 inches grade for a 12 ft. box. Cemented gravel gave a duty of 10. At Wisconsin Hill using the same grade in the sluices a duty of 10 was obtained, and 3 on cemented gravel.

Probable Yardage and Yield for the Season.

Calculating on 1000 miner's inches for a season of 150 days and an intermediate duty of 4 we should obtain a season's yardage of 150,000x4=600,000 cubic yards. The district as a whole should readily attain this.

The second report of the State Mineralogist (1882) gives the yield from some of these gravels in some Notes on Hydraulic Mining by E. W. Robinson, page 170.

The Morning Star Mine gave 37 cents per miner's inch and moved 5.61 cubic yards per miner's inch. This is equivalent to 5.6 cents per cubic yard.

The Orion yielded 50 cents per miner's inch and moved 10.19 yards, which is equivalent to about 5 cents per cubic yard of gravel.

The Sailor's Union Hydraulic Mine yielded 10.7 cents per cubic yard and the Vaugh claim 34 cents (Whitney p. 117). In most cases there is no reliable record of the values. It is probable that the yield would be much greater than 5 to 7 cents, as the Big Dipper was not worked to bedrock at that time.

The Lost Camp Mine in Blue Cañon would be benefited by a dam in the North Fork American River. It was worked in 1916, using water purchased from the Pacific Gas and Electric Company at 10 cents per M. I. D. (see Mines and Mineral Resources of Placer

County, California State Mining Bureau, Dec. 1916, p. 106). The Park and Brown Mine would also work on this river using water from Deep Creek, (see the same report, p. 107).

FOREST HILL.

In Lieut. Col. Mendell's report of 1881, Ex. Doc. 98, p. 109, Andrew Larson, giving an estimate for Forest Hill, northern part, says: "This part was most difficult to estimate because it is all covered with lava, excepting a very small space, and the hydraulic working depends upon how far the lava material keeps soft; when it gets to be rocky or hard the hydraulic mining is finished. He allowed a possible 19,360,000 cubic yards."

The 1891 report of the Board of Engineers (Ex. Doc. No. 267, p. 85) estimated that 6,000,000 cubic yards are available, and with tunnels 12,000,000 might be developed. For Smith's Point and Yankee Jim's, 3,000,000 to 5,800,000. These mines on the north side of the Forest Hill Ridge discharge into Shirttail Cañon, which joins the North Fork American above the site most favored for building a dam. Unfortunately there is little likelihood of hydraulic work on this side of the ridge, although previous reports say that there would be some.

Yankee Jim deposits are finished; Georgia Hill on the other side of Devil's Cañon has been worked inwards until one-half of the bank shows andesite capping as thick as the gravel, and the cover on the other half will increase rapidly. Nevertheless, residents of Forest Hill expect hydraulic work to be done here. Smith's Point, east of Yankee Jim's, shows two spurs of gravel that would be easily washed in continuance of old work, but this is not where values seem to have been high. The greater part of the hydraulic work was carried on along the run of a well defined channel until the andesite cover was very thick. This is shown in two pits. At the Mayflower a lot of shallow hydraulicking was done, large areas of top gravel were removed until a layer of tuff was met that seemed to form a good substitute for bedrock for washing operations. A large pit was thus formed round the site of the Mayflower shaft and also in other places.

I have not counted on any yardage from these places, but if work started the debris produced would be accommodated by a dam on the North Fork American River at the Owl Creek site on the North Fork site.

Forest Hill was carefully surveyed and reported upon by Ross E. Browne in 1890, see X Report of the California State Mineralogist, and by John Hays Hammond in 1889, see IX Report of California State Mineralogist, p. 105.

An excellent map of the district was published with that Report, likewise one of the Iowa Hill field.

Forest Hill is essentially a drift mining district. Its mines have been rich, and the map shows mining claims at the old town on the south side of the ridge below the present town, narrower than those on any other field. The ability to hydraulic for a while to uncover the bedrock and determine the run of the channel may be of great assistance to subsequent drifting. This makes it simpler to determine where bedrock tunnels should be started in order to arrive under the center of the channel and have enough grade.

LOST CAMP.

This mine in Blue Cañon was not inspected. It has been worked with water bought from the Pacific Gas & Electric Company's ditch at 10 cents per M. I. D.*

10,000,000 cubic yards are claimed to be available. Debris is restrained by a wire basket fill dam. To pay when worked in the above manner, the contents probably average 15 cents per cubic yard.

Annual yardage would depend upon water available over and above the needs of the Pacific, Gas and Electric Company.

50,000 cubic yards at 15 cents=$7,500.

In 20 years the output would exceed $150,000, probably by a large amount, dependent chiefly on water available.

---

*See also Mines and Minerals of Placer County, California State Mining Bureau, Dec., 1916, p. 107.

GRAVELS OF THE MIDDLE FORK OF AMERICAN RIVER.

Estimates of Gravels on Middle Fork of the American River—Quantities in Millions of Cubic Yards.

Name of report	Whitney	Mendell	Board of Engineers	U. S. G. S.	This report
Engineer	(Pettee)	(Larson) Ex. Doc. No. 98	(Turner) Ex. Doc. No. 267	(Lindgren) Prof. Paper 73	(Jarman)
Year made	1879	1881	1891	1911	1926
Forest Hill, South Side	No estimate	No estimate	------------	No estimate	------------
Paragon (Bath)	No estimate	No estimate	24.5	------------	Over 15
Dardanelles and Baltimore	No estimate	No estimate	5.5	No estimate	Over 3
Todd's Valley and Spring Garden	No estimate	No estimate	5.0	No estimate	Nil
Michigan Bluff	No estimate	No estimate	------------	------------	------------
Big Gun	No estimate	No estimate	23.1	No estimate	Over 3
Sage Hill	No estimate	No estimate	------------	------------	Not estimated
Totals	------------	------------	58.1	------------	Over 21

Rate of Work Expected on the Middle American River and Production for the First Twenty Years.

Mine	M.I.D. available	Duty	Per annum		Twenty years	
			Yardage	Yield	Yardage	Yield
Forest Hill, South Side:						
Paragon (Bath)	110,000	4	440,000	$44,000	8,800,000	$880,000
Baltimore and Dardanelles	40,000	2	80,000	10,400	1,600,000	208,000
Michigan Bluff:						
Big Gun	72,000	2	144,000	12,960	2,880,000	259,200
Sage Hill	Not estimated	--------	------------	------------	------------	------------
Totals	222,000	--------	664,000	$67,360	13,280,000	$1,347,200

Middle Fork of American River.

MICHIGAN BLUFF.

The Big Gun. In this district there is the Big Gun mine with 400 miner's inches available. For a season of 180 days this gives 72,000 M. I. D. One bank of gravel here contains over 2,000,000 cubic yards. There is also the site of the old town which was built on gravel. Only the bottom gravel is cemented and the duty obtainable would be 2 or more. This mine is mentioned in Ex. Doc. 267, p. 93, as difficult to work (the reasons are not given) and as having been sold to satisfy judgments. Nevertheless it is still fitted up to work (1926) and negotiations are under way for working it again. The yield of the gravel is not recorded, and it has been assumed as 9 cents per cubic yard. The ground falls rapidly to the river so that grade would not be difficult to obtain.

Keokuk Point, about 1 mile west of this has been completely worked off and the bedrock cleaned.

Sage Hill, two miles to the west shows gravel on several points or spurs jutting out into the canyon of Birds Valley. These deposits are irregular and so much overgrown that no estimate of quantities was possible. Some hydraulic prospecting was being carried on.

SOUTH SIDE OF FOREST HILL.

Mines on the south side of Forest Hill drain into the Middle American River.

Baltimore and Dardanelles. At the Dardanelles there is a bank of gravel left because the reservoir was above it. To the east of this the Baltimore has a point on which there is estimated to be at least 2,000,000 cubic yards. The Dardanelles formerly yielded 13 cents per cubic yard.* This gravel is cemented but would wash readily at a duty of 2 after blasting. 48,600 M. I. D. were used in 1880. Much more would be available if the ditches were cleared.

The Paragon Mine at Bath (also called the Breece and Wheeler) could easily be fitted for work and has two ditches. The Tod's Valley or Pond ditch with 600 miner's inches from Volcano Cañon and the Breece and Wheeler Ditch with 1500 miner's inches from El Dorado Cañon; 113,500 M. I. D. from these streams were used on this side of Forest Hill in 1880. No water has been taken for other purposes on this ridge, and more water would be available as the mines on the north side of Forest Hill would not be using it, but the ditches would need clearing. From 1874 to 1879 this mine was worked by hydraulic method only and produced $243,075.87 from which dividends were paid amounting to $119,670.14. This yield of gold equalled $2.54 per miner's inch of water used, a high return (see Ex. Doc. No. 98, p. 24). The IX Report of the California State Mineralogist records that a bank of gravel 70 feet high gave 74.2 cents per cubic yard 124,000 yards yielding $92,000.00. Another bank 71 feet high gave 78 cents per cubic yard, 22,275 yards yielding $17,387.78.

When hydraulic work was stopped, this mine was drifted at the bottom or Blue Lead and also on a richer pay streak called the Paragon 160 feet above bedrock and a third streak called the Orono; from these it gave regular returns.

As a result of this drifting, future hydraulic results would be lower. The bottom gravel contains many large boulders, some being granite. The ordinary gravel contains pebbles stained green with chlorite, which the miners say is a very favorable indication for gold.

Above the gravel there is a cover of tuffs and then andesite. This would reduce the returns, but the andesite has been eroded so that the amount of cover would not increase much for 100 yards of work behind the present bank. Gravel miners consider this mine is rich, but the barren cover must be moved. When drifting had been carried on for 3850 feet, a barren channel filled with volcanic material was encountered (Whitney p. 94). Drifting was done over a width of 200 to 300 feet and the trough was stated to be 4000 feet wide.

About 15,000,000 cubic yards could be worked without trouble from the andesite cover. The yield is difficult to forecast. In many districts the old miners piped away the overburden and lighter top gravel and got rid of it as fast as possible. Having done this they prepared to pipe the "gravel" and if they estimated the quantity of gravel piped or the returns from a bank it was usually "pay gravel" that they considered. Top stuff was only cover or surface material, not worthy of consideration. A bank of 70 feet carrying 76 cents per cubic yard, covered with 100 feet of light gravel probably 15-cent material, and 200 feet of barren tuffs and andesite which the bank now shows would average 18 cents per cubic yard for the whole bank. Ten cents has been used for this calculation because the large amount of drifting that has been done would reduce the former values considerably.

---

*Ex. Doc. No. 98, p. 23.

Assuming the ditches to have half capacity there would be 1000 miner's inches, and a season of 180 days would give 180,000 M. I. D. In 1880 there were 113,000 M. I. D. used in this district. 110,000 M. I. D. has been assumed and a duty of 4 (there is plenty of grade and $\frac{3}{4}$ of the bank is easy to move).

The season's work would be:

110,000x4=440,000 cubic yards,

and the yield would be:

440,000x10c=$44,000.

The production of this mine when hydraulicked was about $55,000 per annum.

GRAVELS OF BEAR RIVER.

Estimates of Gravels on Bear River (Including Greenhorn and Steephollow)—Quantities in Cubic Yards.

Name of report	Whitney	Mendell Ex. Doc. 98	Board of Engineers Ex. Doc. 267	U. S. G. S. Prof. Paper 73	This report
Engineer	(Pettee)	(Larson)	(Turner)	(Lindgren)	(Jarman)
Year made	1879	1881	1891	1911	1926
Lowell Hill	----------	None	1,200,000	----------	----------
Liberty Hill	----------	1,645,600	6,000,000 to 10,000,000	16,000,000	Over 4,500,000
Elmore Hill and Nary Red	----------	Nil	----------	----------	?
Dutch Flat: Polar Star Channel Gold Run Channel	No estimate	8,500,000	30,000,000 to 36,000,000	Much less than 90,000,000	4,710,000 17,286,000 to 34,573,000
Christmas Hill	No estimate	605,000	1,500,000	----------	Over 440,000
Little York	No estimate	484,000	1,600,000	Nearly finished	Over 3,000,000
You Bet (including Red Dog, Nevada, Niece and Wests, Brown Hill)	----------	9,680,000 4,840,000	30,000,000 to 75,000,000	100,000,000	20,000,000
Walloupa	----------	(Sailor Flat)			
Chalk Bluff	----------	4,840,000			Too cemented
Buckeye Hill	----------	----------	4,000,000 to 5,200,000	Nearly finished	
Hunts Hill (or Gouge Eye)	----------	2,420,000		----------	Over 5,000,000
Quaker Hill	----------	16,262,400	90,000,000	140,000,000	
Remington Hill	----------	484,000	1,000,000 to 6,000,000		
Excelsior Point	----------	----------		----------	----------
Pleasant Hill	----------	58,080	----------	----------	----------
Wolf Creek Basin	----------	----------	100,000 to 500,000	----------	----------
Totals	----------	49,819,080	121,100,000 to 227,000,000	----------	Over 32,940,000

Rate of Work Expected on Bear River and Production for First Twenty Years.

Mine	M.I.D. available	Duty	Annual		Twenty years	
			Yardage	Yield	Yardage	Yield
Lowell Hill and Liberty Hill	275,000	1½	350,000 to 525,000	63,000 to 94,500	7,000,000 to 10,500,000	1,260,000 to 1,890,000
Foss	30,000	2	60,000	5,400	1,200,000	108,000
Little York and Christmas Hill	75,000	2	150,000	22,500	3,000,000	450,000
Elmore Hill, Dutch Flat, Polar Star, Southern Cross, Jehoshaphat, etc.	*	1	----------	----------	†	----------
You Bet, Brown's Hill, Walloupa, Red Dog, Nevada Hydraulic	380,000	1½	570,000	85,500	11,400,000	1,710,000
Hunt's Hill, Quakers Hill	54,000	2	108,000	16,200	2,160,000	324,000
Totals	760,000	----------	1,238,000 to 1,413,000	192,600 to 224,100	24,760,000 to 28,260,000	3,852,000 to 4,482,000
Average	----------	----------	1,325,500	$208,350	26,510,000	$4,167,000

*Purchased from P. G. E. Co. ditch or developed from other sources.

†Output not calculable until water available is known.

In 1880 the total water used for hydraulic mining on Bear River was 1,117,082 M.I.D. which was estimated to have duty of 3, giving an annual yardage of 3,351,246. There was a large volume of top gravel in this, the yield from which would be low.

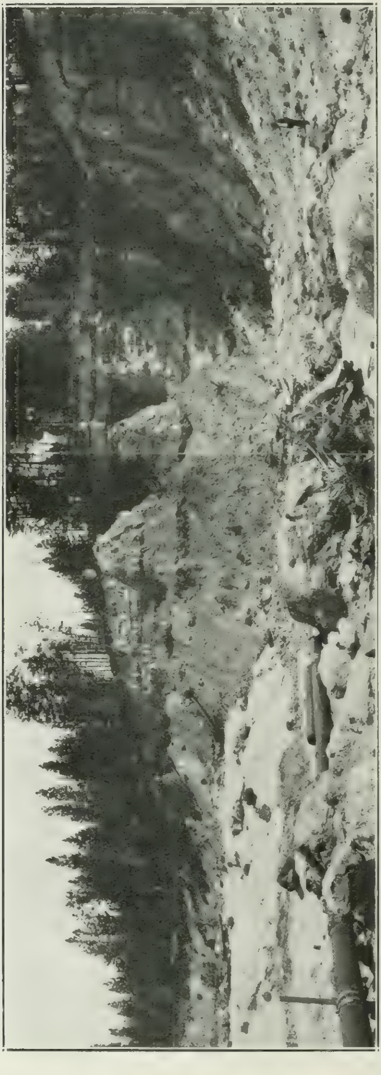


Photo by Arthur Jarman.

LIBERTY HILL MINE, ON BEAR RIVER.

This mine has worked intermittently since the injunctions, debris being caught in a log crib and rock-fill dam opposite Dutch Flat. The dam has been raised from time to time to increase its capacity. A concrete dam will enable steady work to proceed on all mines on that river.

BEAR RIVER.

LIBERTY HILL AND LOWELL HILL.

A channel from Lowell Hill runs through Liberty Hill, crosses Bear River to Elmore Hill, then crosses Little Bear Creek to the Polar Star Pit and thence joins the main channel at Dutch Flat. The gravel is readily traced over this country. At Lowell Hill much drifting has been done and some hydraulic work.

SWAMP ANGEL MINE.

Some preparations were made to hydraulic in 1921 and 1923 but the small concrete dam built for this purpose became filled with tailings brought down by freshets.

FOSS MINE.

Preparations are under way for hydraulic work. The owners claim to have a large yardage on this channel and propose to use 30,000 M. I. D. per season at the commencement of hydraulic work. The mine was not visited.

LIBERTY HILL MINE.

Liberty Hill is southwest of this and has been worked from time to time since injunctions obliged the miner to provide dams. There is a log crib and rock fill dam below Little Bear Creek on the Bear River which is used by this mine. A report by P. D. Burt made in 1916 estimated that 8,000,000 cubic yards was available that should yield 16 cents per cubic yard.

Reporting in 1925, L. A. Decoto estimated the gravel as averaging 19 cents per cubic yard, the top gravel giving a duty of 2 and the bottom a duty of one-fourth yard per miner's inch. The top material is easy to move and should do better than this, but the bottom gravel is often so cemented that it must be shattered by powder before attacking it by water. Various estimates have been made of the quantity of gravel that remains. The owner of the Liberty Hill Mine estimated 4,500,000 cubic yards on his ground alone.

Ex. Doc. 267, p. 85 estimates 6,000,000 to 10,000,000 cubic yards. Lindgren quotes 16,000,000 as remaining. The bank is only 40 to 80 feet high and about 600 feet width of channel is worked. This would mean 4,000,000 cubic yards in the next 1000 yards of channel.

The gravel appears to be continuous to Lowell Hill, a distance of about 4000 yards, all covered by timber. Six shafts put down near the rim to determine the width of pay channel are reported by Mr. W. Maguire to have averaged 15 cents per cubic yard. Three shafts were sunk ahead of the pit to determine the continuation of the channel and its values. Two have since been worked out.

The owner of the mine (Mr. W. Maguire of Nevada City) submitted figures showing that the mining of 1,200,000 cubic yards of gravel produced $210,000 between the years 1896 and 1915. This is at the rate of 18.3 cents per cubic yard. The last work was in the season 1920-1921 when W. S. Bliss washed 131,049 cubic yards of top gravel for a return of $18,192.81 and the glacial gravel underlying it was afterwards blasted and piped, 21,500 cubic yards giving a return of $17,526.61. These quantities of gravel were determined by survey by Mr. Uren. This is at the rate of 13.88 cents for top gravel and 81.5 cents for bottom gravel, and 23.4 cents average for the whole bank.

Rate of Work Possible.

2000 M. I. of water are available for a season of about 150 days and after that 500 M. I. for another 100 days.

150 x 2000=300,000 M. I. D.
100 x 500= 50,000 M. I. D.

Total-----350,000 M. I. D.

At a duty of 1 to 1½ cubic yards per M. I. D. this gives 350,000 to 525,000 cubic yards of gravel for the season. At 18 cents per cubic yard this would yield from $63,000 to $94,500.

DUTCH FLAT.

The channel from Liberty Hill crosses Bear River to Elmore Hill and Nary Red.* At the latter place hydraulic work has proceeded in several pits, the light surface gravel has been washed off, and some of the heavy gravel below it, exposing slate bedrock. The bank has been drifted. At Elmore Hill only the light upper gravel has been washed off. This hill is a direct continuation of the channel which can be seen to cross Bear River from Liberty Hill; from Elmore Hill it crosses Little Bear River and is seen on the opposite bank in the Polar Star Pit and so it passes on to Dutch Flat. All this area on the Dutch Flat Side (or south side) of Bear River would have to purchase water unless some new source of supply could be developed.

This fact coupled with the heavy nature of the bottom gravel and its cemented character makes future operations doubtful.

POLAR STAR.

This mine worked down to bedrock, as did the Southern Cross in one of its pits. The bottom gravel is 60 to 90 feet thick and is glacial, with large boulders and strongly cemented near the bedrock. Some of the boulders are over 10 feet in diameter. Figures given by W. H. Pettee showed that the top gravel yielded 11 cents, (Whitney p. 425). W. Nichols who owned and operated the Polar Star and Southern Cross up to and during the trouble with injunctions, figures that this gravel yielded 25 cents after having been drifted, the bottom portion yielding 40 cents.

The water used in the last work done here was purchased from the Pacific Gas and Electric Company's ditch and cost 10 cents per M. I. D. It is an open question whether this heavy bouldery cemented gravel would pay to work under present day conditions with water at this price. When washing heavy material the water duty is low, and after blasting the cemented gravel, an economical method of handling heavy boulders would be required. The mine should be credited with stacking this heavy material in the mine pit if a charge per cubic yard is made for impounding debris.

---

*Nary Red means no red, the gravel being characterized by white quartz which is now shipped to brickworks and sometimes to smelters as a pure silica flux, about 98% SiO_2.

SOUTHERN CROSS AND FRANKLIN.

The Southern Cross Mine exhibits heavy glacial gravel in one pit where worked to bedrock. Elsewhere on this mine and in the Franklin, the old miners washed the lighter top gravel and left the heavy cemented bottom gravel. There is some of this lighter gravel available here, and in adjoining ground.

DUTCH FLAT.

After this Liberty Hill channel runs past the town of Dutch Flat, it joins the main Blue Lead, a little south of the town. The Blue Lead or big channel comes from Gold Run, crosses the railway and swings to the west past the town, crosses the Bear River, passing on to Little York. From here it crosses Steep Hollow, passes on to You Bet, and Red Dog, then crosses the Greenhorn and continues through Hunts Hill and Quaker Hill. All these gravels eventually find their way down Bear River if hydraulicked.

Most of the top gravel has been washed off at Dutch Flat; Lindgren (writing in 1911) says, 90,000,000 cubic yards of it and Turner (in 1891) in Doc. 267 says 105,000,000 cubic yards.

The area of gravel exposed is large. To estimate the yardage remaining, the central portion or main run of the channel was calculated and found to have an area of approximately 647,100 square yards, omitting some rim ground, and the area that the town occupies.

According to the positions of bedrock exposed by shafts and drifts, the depth of gravel on this area varies from 130 feet in the Southern Cross Pit to 200 feet on the main run of the Blue Lead, and is supposed to be 250 feet or more at the railroad. From this I calculate that 34,573,000 cubic yards of gravel remain. Information concerning the position of bedrock is meagre however, and some factor of safety is desirable. There is no evidence of faulting on the Blue Lead and the worst that could happen would be for the shape of channel to change from the flat contour that it exhibits near Bear River and at Gold Run, and assume a steeply sloping V shape. This is unlikely, but the effect would be to halve the quantity and give only 17,286,000 cubic yards. I therefore conclude that there is from 17,000,000 to 34,000,000 cubic yards of gravel on this ground.

These figures show that there is a problem worthy of attack, viz:—the beneficiation of this large volume of gravel.

Information concerning its gold contents between Dutch Flat and the railroad is meagre, but Lindgren (p. 144) says all this ground was drifted. Whether it can be worked at a profit cannot be told without further information. There is, however, a large amount of top gravel that would be easy to wash. In the table of available gravel, 17,286,000 to 34,573,000 of bottom gravel at Dutch Flat is included tentatively.

CHRISTMAS HILL AND LITTLE YORK.

Christmas Hill is a continuation of the Little York gravel. It is also known as the Baltimore Placer. The gravel is small and easily washed giving a duty of 4 to 5 cubic yards per miner's inch. It is reputed to yield 9 to 10 cents per cubic yard giving $200 per day regularly when working with 500 miner's inches. An entry in the old accounts* showed that two months work in March and May 1877 produced $7,984.86 when using 500 M. I. from Bear River ditch. The yardage moved would be approximately:

$$500 \times 4\tfrac{1}{2} \times 2 \text{ months} \times 26 \text{ days per month} = 11{,}700 \text{ cubic yards.}$$

The yield is therefore equivalent to about 6.8 cents per cubic yard.

The gravel remaining on the top bank contains 440,000 cubic yards by survey, and there is a lower bank not surveyed.

In the 1881 Report (Ex. Doc. 98, p. 108) the gravel for these areas was given as 1,089,000 cubic yards.

In the 1891 Report (Ex. Doc. 267, p. 85) Little York is credited with 1,600,000 and Christmas Hill with 1,500,000, a total of 3,100,000 cubic yards. The owner claims a much larger amount than this on Little York alone. There is the gravel occupied by the ruins of the old town, and this bank continues down the side of the channel. The bottom gravel is cemented, particularly the lower 20 feet. The top gravel is said to carry 8 to 10 cents and the cemented bottom gravel 20 cents.

LITTLE YORK.

This company's patent of 1872 included the Liberty Hill, Christmas Hill and Little York mines.

The following bullion figures were taken by me from bullion certificates and accounts of the old Little York Water and Mining Company, in the possession of Mr. W. Maguire of Nevada City.

April 21, 1873, to April, 1874, and then to Sept., 1874, certificates, totalled	$96,228.81
Sept., 1874, to Dec., 1875—certificates totalled	71,191.78
Total from April, 1873, to Dec., 1875	$167,420.59

The new company transferred its office to San Francisco, 330 Pine Street, and all records there were burned in the fire of 1906.

Water Rights.

1400 M. I. for 6 months, there being about 26 piping days in the month. The yardage treated for the season with a duty of 2 yards per M. I. D. would be:

$$1400 \times 2 \times 6 \times 26 = 435{,}800.$$

The 29 months during which the above bullion was obtained would enable the following yardage to be washed:

$$\frac{29}{12} \times 436{,}800 = 1{,}055{,}600 \text{ cubic yards}$$

---

*Accounts of the Little York Company which owned this ground and the Liberty Hill as well.

A yield of $167,420.59 would be at the rate of 15.8 cents per cubic yard, with a duty of 2 yards per miner's inch. The bottom gravel is strongly cemented, but the middle and top gravel is easy to wash.

Rate of Work and Yield Expected.

Using 75,000 M. I. D. from the Bear River Ditch or Maguire Ditch and averaging the duty between the upper and lower gravel at 2 cubic yards per M. I. D. there would be 150,000 cubic yards moved. At 15 cents this would yield $22,500 for the season.

YOU BET DISTRICT.

Between Steep Hollow and Greenhorn, both tributaries of Bear River, the channel has been worked by mines famous in the early days of hydraulic mining, Brown's Hill, Niece & West, Walloupa, Nevada Hydraulic, You Bet, Red Dog, Husseys and Chalk Bluff. These are now consolidated under one ownership. Some excellent gravel remains, and work has proceeded at various times since the injunctions took effect. If the debris were taken care of by a dam, this property would pay to work.

Mr. William M. Strong, mining engineer of Denver, Colorado, examined the gravels in June 1915 and reported 20,000,000 cubic yards of gravel that will yield 10 to 15 cents per cubic yard. About 7,500,000 cubic yards would be discharged into the Greenhorn and the other 12,500,000 into Steep Hollow. Mr. Strong's estimate of the value of the gravel is based upon his own sampling and upon past returns from the mines. If the opinions of miners that have worked in this district may be expressed, this estimate of 10 to 15 cents is below what is expected by them. When hydraulic work was in full swing, there was difficulty in securing grade for sluiceboxes, because the beds of these two rivers filled with debris until the outfall of the boxes were chocked. Both rivers from which water is obtained are short, their drainage areas being: Greenhorn 7⅕ square miles and Steep Hollow 17½ square miles.

The small sizes of these areas are partly compensated for by good rainfall in the higher part of the basin. Additional water might be brought from the South Yuba by a ditch that formerly brought water down the Chalk Bluff Ridge.

Concerning the Red Dog section of this property Mr. Strong reported that under the conditions of 1915 (necessitating impounding by their own dam) there was 3,000,000 cubic yards available. 26 rocker samples of this averaged 25.8 cents per cubic yard, and the cost of working he estimated at 10 to 15 cents.

Mr. F. A. Goodale was in charge of the You Bet property from 1915 to 1920. He says that of the 2½ miles of channel there is still ¾ mile that is untouched, neither hydraulicked nor drifted. In the last operations at Brown's Hill, about 45,000 cubic yards was washed and produced $10,000, a little over 20 cents per cubic yard. At the Red Dog 60,000 cubic yards produced less than $10,000, but panning tests indicate 25 cent value. He considers 15 cents a safe estimate here. The Nevada Tunnel mine stopped in 1918 for lack of grade, 30 feet being required to give elevation in the sluices. This he estimates as 20 cent gravel, and 15 cents may safely be calculated on. Summing up he says that there is from 12,000,000 to 24,000,000 cubic yards of 15 to 17 cent gravel that can be washed if a debris dam is provided.

Mr. H. B. Adsit reported in 1909 that this gravel would average 25 cents per cubic yard for a width of 500 feet and a depth of 25 feet all along the channel. This value was determined from panning tests and previous records.

Rate of Work Possible.

Water is brought in by three ditches, the English Ditch from Steep Hollow, capacity 1400 M. I.; the Irish Ditch from North Fork of Steep Hollow, capacity 1400 M. I.; and the Stehr Ditch from Little Greenhorn, capacity 1000 M. I. This is a total capacity of 3800 miner's inches and would give a large output if the ditches could be kept full.

The catchment areas of these streams is small and the water season would not last long after the rains stopped. A season of at least 100 days should be obtained, as the rainfall in this district is over 45 inches. This would give 380,000 M. I. D. for the rainy season, after which some work could proceed on a smaller scale difficult to estimate. One of these mines, the Nevada Hydraulic used 420,500 M. I. D. in 1880. 380,000 at a duty of 1½ gives a yardage of 570,000 and at 15 cents this yields $85,550. If grade can be maintained in the sluices, particularly at the Nevada Mine, these figures will be exceeded without difficulty.

HUNT'S HILL, QUAKER HILL, AND BUCKEYE HILL.

When the channel crosses Greenhorn River it continues northward to Scott's Flat on Deer Creek. Mines were worked between these rivers at Hunt's Hill (formerly called Gouge Eye) and northeast of this, at Quaker Hill. From Hunt's Hill the gravel also passes north under the lava and tuffs that cap the ridge emerging at Scott's Flat. This is on Deer Creek, a tributary of the South Yuba.

Opposite Hunt's Hill, on the other bank of the Greenhorn is Buckeye Hill which is only bench gravel and almost all of it removed.* Hunt's Hill and Quaker Hill both discharge into the Greenhorn, thence into Bear River. Quaker Hill gravels are described by Lindgren as being nearly 600 feet deep in the centre of the channel; 35,000,000 cubic yards worked off and 140,000,000 remaining. Turner in Ex. Doc. 267 says 35,000,000 worked, and from 50,000,000 to 90,000,000 remaining, but (p. 92) "unavailable for the greater part by lack of grade for the sluices." This difficulty prevents the richer deep gravels from being worked without elevators, but a shaft was sunk and some drifting done. The banks of the hydraulic pit have been worked in under the tuffs and andesitic material that covers the gravels. Considering all these things, the enormous amount of gravel recorded at Quaker Hill must be regarded as unavailable for hydraulic working under present conditions. Mr. Geo. C. Sargent who had the records of Quaker Hill, lost them in the San Francisco fire of 1906. W. H. Pettee estimated the upper gravels here as carrying 6.6 cents per cubic yard.*

---

*See Lindgren, p. 144, and Turner, in Ex. Doc. 267, p. 92.

HUNT'S HILL.

Hunt's Hill gravel is continuous with that of Quaker Hill but a ridge of tuffs and andesite separates the mining pits.

Hunt's Hill workings are close to the river and bedrock is high enough to enable work to proceed without elevators. The bottom 40 or 50 feet of gravel is cemented, some of it strongly, and stamp mills were the rule for treating it.**

Turner (Ex. Doc. 267, p. 85) estimated that 6,750,000 cubic yards had been removed and 4,000,000 to 5,000,000 was still available. Most of this is cemented bottom gravel similar to that at You Bet and Red Dog, but there is also some light top gravel.

The water used at Hunt's Hill and Quaker Hill came from two ditches, the Union Ditch and Jacob and Sargents. The latter came from Greenhorn Creek, Whitney, p. 424 says Greenhorn Creek supplies 800 miner's inches per day for 9 months to the Quaker Hill Mine.

Mr. W. Maguire estimates that the two ditches supplied 1000 to 1200 miner's inches for a season of 150 days. Jacobs and Sargeant used 54,000 M. I. D. in 1880, according to Ex. Doc. No. 76. This small quantity of water with a duty of 2 would give 108,000 cubic yards for the season. At 15 cents per cubic yard this would yield $16,200.

Summary of Bear River Grounds.

This district is hampered by lack of water and sometimes lack of grade for sluice boxes preventing work upon most promising gravels. The table therefore shows a large aggregate amount of gravel but a very small production from it.

Additional Water Supply.

The Cascade Ditch of the Nevada Irrigation District brings water to the old town of Quaker Hill at an elevation of about 3300 feet. The supply of water from this ditch affords hope of working more gravel at Hunt's Hill and at You Bet or Red Dog.

---

*See Whitney, p. 425.

**Mr. Thos. Brady at You Bet recalls stamp mills being used at the following claims: Mallory Bros., Hayward; Couzzen Bros., at Nevada Mine; Judge Barker, Old Red Dog, Bunker Hill (Brady's Mine), Turners (at Hunt's Hill), Carny and Goodspeed (where Chinese worked later at Hunter Hill), Sargent & Jacobs (at Quaker Hill).

GRAVELS OF THE SOUTH AND MIDDLE FORKS OF YUBA RIVER.

Estimates of Gravels on South Yuba and Middle Yuba Rivers—Quantities in Millions of Cubic Yards.

Name of report	Whitney	Mendell	Board of Engineers	U. S. G. S.	This report
Engineer	(Pettee)	(Larson) Ex. Doc. No. 98	(Turner) Ex. Doc. No. 267	Lindgren Prof. Paper 73	(Jarman)
Year	1879	1881	1891	1911	1926
South Yuba:					
North Bloomfield	700	No estimate	65	130	Over 50
Lake City			110	Probably 130	
Last Chance, Porter and Brockmeyer			40		
Relief Hill			15	No estimate	15
Washington			3		Over 3
Blue Tent and Sailor Flat		4.84	30 to 60	90	2
Grizzly Hill		1			
French Corral		1			
Omega			20	40	24
Alpha				1	
Totals for South Yuba			283 to 313	400	Over 94
Middle Yuba:					
San Juan and part of American Mine			2.5		
Badger Hill and Cherokee			33		
Patterson			96		Over 442
Wolsey Flat			1.5		
Moore's Flat, Orleans Flat and Snow Point)			14.2		Doubtful
Totals for Middle Yuba			147.2		Over 442

Rate of Work Expected on South Yuba and Middle Yuba Rivers and Production for First 20 Years.

Mine	M.I.D. available	Duty	Per annum		For twenty years	
			Yardage	Yield	Yardage	Yield
South Yuba:						
Bloomfield Hydraulic and Lake City	650,000	4	2,600,000	$260,000	52,000,000	$5,200,000
Blue Tent	15,000	2	30,000	4,500	600,000	90,000
Relief Hill	120,000	3½	420,000	37,800	8,400,000	756,000
Washington	145,600	1	145,600	47,320	2,912,000	946,400
Omega	358,000	3	1,074,000	139,620	21,480,000	2,792,400
French Corral, etc.			Not benefit	ed by a dam	at Jones Bar	
Totals	1,288,600		4,269,600	$489,240	85,392,000	$9,784,800
Middle Yuba:						
Badger Hill or North Columbia District, Moore's Flat District	650,000	4	2,600,000	$260,000	52,000,000	$5,200,000
Totals for Middle and South Yubas combined	1 938,600		6,869,600	$749,240	137,392,000	$14,984,800

SOUTH AND MIDDLE FORKS OF YUBA RIVER.

Between these two rivers lies the largest body of gold bearing gravel capable of being worked by hydraulic methods. It extends from Badger Hill to North Bloomfield, a distance of 9 miles. At the western end near Badger Hill the top soil and gravel was washed away from an area approximately four miles long and ½ to 1¼ miles wide. This area extends from Badger Hill and Paterson to where Spring Creek crosses the deposit about a mile to the east of North Columbia or Columbia Hill.*

From Spring Creek the gravel continues eastward covered by trees and undergrowth for about a mile when we find the hydraulic workings of the Union Mine. To the east of this the gravel continues untouched through Lake City where it passes under an andesitic cover forming a ridge 400 feet high. About 3 miles from Spring Creek we reach the western bank of the hydraulic pit of the Bloomfield Hydraulic Mine (also known as the Malakoff Mine). In traversing this pit and the gravel at the far east end we travel another 2 miles before the gravel disappears under a cover of andesitic tuffs, lavas and breccia.

This brief description covers a gravel channel 9 miles long and ½ to 1¼ miles wide, which contains over 800,000,000 cubic yards of gravel, computed from reliable survey data.

This enormous body of gravel was formed by several big rivers that joined each other in the course of the 9 miles. One came from the east and flowed west through Snow Point, Orleans, Moore's Flat and Derbec to North Bloomfield and so on down the big channel already described. Another flowed west through Omega and Alpha, then Relief Hill and on to Bloomfield and Malakoff and down the main channel described. A much larger river flowed north; it started from Michigan Bluff, passed through Forest Hill, Yankee Jim to Iowa Hill across to Indiana Hill and through Gold Run to Dutch Flat. Here it was joined by the Liberty Hill stream coming west, then on to Little York, You Bet and Red Dog, Hunt's Hill and Quaker Hill to Scotts Flat. From here it continued north but is covered by andesite and is found again at Sailor Flat and Blue Tent after which it crosses the course of the present South Yuba River to Grizzly Hill and joined the big channel at Spring Creek. Having combined their forces these rivers travelled as one big stream through the Columbia Hill area. Top gravel has been removed by mining from here down to Badger Hill. Further west the gravel was found and mined at North San Juan, Sebastopol, Sweetland, Birchville and French Corral, and again lower down the river at Smartsville. Most of the gravel at and below North San Juan has been worked but there are some banks that may be profitable if dams could be arranged and particularly at Smartsville and vicinity, where there is a large quantity of gravel which paid well in former times. The latter, however, lies below the damsite at the

---

*These two names are interchangeable; the post office is called North Columbia but the town is known as Columbia Hill, which leads to confusion until the visitor becomes conversant with the names, especially as old maps show Columbia Hill as a settlement 4 miles east of this.

Narrows, and at this place the Yuba leaves the Rocky gorge and widens into a broad stream that is difficult to dam.

The origin or formation of these gravels was interpreted in this way by early miners, the channels of each district being studied carefully as their drift mine workings show. River action, glacial action and sea beach action each had their advocates. We now know that glacial action was chiefly responsible for carving these valleys in slate and other bed rocks, often leaving remarkable evidence of ice action. Glacial gravel and morainal material frequently occupies the bottom of the trough; above this is found heavy river gravel and finer gravels, with sandy layers at times. Still higher are finer gravels, sands, tuffs and sometimes clays.

Geologists and others accustomed to record their observations in permanent form were attracted to these famous gold fields and we have Prof. T. D. Whitney's records of the examinations and data collected by Mr. W. A. Goodyear in 1871 and by Prof. W. H. Pettee in 1879, also those of engineers of the California State Mining Bureau, notably Henry DeGroot in "Notes on Hydraulic Mining," Report for 1880; Russell L. Dunn in "Drift Mining in California," Report for 1888, VIII; John Hays Hammond in "The Auriferous Gravels of California" in the Report for 1889, IX.

Still later, the U. S. Geological Survey assigned to Mr. Waldemar Lindgren the duty of studying this area and as a result we have his professional paper No. 73 published in 1911.

Whitney's Volume and Lindgren's Bulletin are both out of print and copies should be guarded with care by those lucky enough to possess them.

Geological features are of interest in enabling the reader to understand influences drawn from data gathered at the mines. All gravels vary in their gold contents on or near the bedrock of the stream, but the main bank of this enormous body of gravel is not likely to vary much in its gold content by reason of the averaging of conditions that occur in the deposition of so large a mass of material.

Mr. W. W. Waggoner of Nevada City, consultant to many gravel mines, has recorded and correlated all the known survey data relating to this area and submitted detailed maps which he made. He mapped the elevations of bedrock exposed by the action of watercourses and by mining drifts, shafts, drill holes, and by actual hydraulic work. In this way he produced a **contour map of the bedrock.** Having the contour of the gravel surface and also of the bedrock that lies below it, the quantity of gravel may be calculated with only a small percentage error. Such data also shows the shape of the deposit and makes it possible to determine the best method of attack.

Consideration of Different Methods of Working This Gravel.

It does not appear to be possible to work this gravel profitably by any method other than that of hydraulicking. The good values that lie in the lower gravel and on bedrock cannot be recovered by dredging as the depth of the deposit is too great—150 to 300 feet.

The largest dredges in the world are those of the Natomas Company of California operating near Natoma, and those of the Yuba Consolidated Goldfields at Hammonton on the Yuba, below the Narrows. The Natoma dredges have buckets of 15 cubic feet capacity and dig 150,000 to 225,000 cubic yards per month and operate at an average cost of 6½ cents per cubic yard;* those of the Yuba Consolidated are of similar size and operate at a lower cost owing to exceptionally favorable conditions. These enormous dredges do not dig deeper than 86 feet, and values in this 86 feet probably will not exceed 6 cents per cubic yard. The gold is chiefly in the bottom layers and the gravel is 150 feet or more in depth; therefore, dredging would not pay, as the richer bottom gravel would be untouched. A plan to dissolve the gold from the gravel as it lies in place using cyanide as a solvent might be feasible but would be subject to percolation difficulties caused by thin layers of very fine sand or clay.

On the other hand hydraulic mining is a positive method that enables all gold to be cleaned from the bedrock and the crevices in it, and the operating costs are the lowest of any method of handling gravel and extracting its gold contents.

The costs at Bloomfield averaged 4.53 cents per cubic yard for the nine year's work. Wages are higher than they were at that time and supplies are more costly, also water; but making due allowance for these things the cost for the actual mining of such gravel should not exceed 7 cents according to engineers of the River Mines Company. The figure will depend upon the methods adopted to obtain a large output with the minimum of labor.

Mr. Waggoner calculates from his survey data that the area described contains 886,600,000 cubic yards of gravel. Another engineer using the same data but calculating by his own method reported 891,000,000 cubic yards. In 1876, while mining was active on this area, Mr. J. D. Hague, mining engineer of New York, estimated that 4400 yards length along the channel would contain nearly 300,000,000 cubic yards of gravel. The gold contents he estimated at fro 6 to 12 cents per cubic yard, but this value was not determined by sampling; it was deduced from returns obtained from mines worl ing along this ridge, which was famous as the 'San Juan Ridge.'

The larger area that we are considering he estimated contained 700,000,000 cubic yards. In making this estimate Hague was obliged to assume the contour of bedrock in places where data had not been obtained. Subsequent estimates made from fuller data show that his assumptions were justified.

Quantity of 'Workable' Gravel.

Mr. Waggoner's figure of 886,600,000 cubic yards represents the total gravel situated so that it would be possible to mine it, without consideration of ownership. Tunnels would be needed from the river banks to enable the gravel to be washed down sluices with sufficient "grade" or fall to give the water good transporting power. Small rim gravels in remote positions were left out of account in the above estimates.

---

*See Report XXI of California State Mineralogist, Jan., 1925, pp. 13 and 14.

Values Contained.

We next have to consider whether sufficient gold is present in this gravel to enable operations to pay. Obviously any gravel that is of too low grade to show a profit must be deducted, and similarly, gravel that shows too large a percentage of clay should be left out of account since clay is difficult to work and causes losses of gold from sluice boxes. Thick bands of clay or barren volcanic "tuffs" or of sand require high values in the remainder of the gravel to give an average for the whole bank that will be profitable. On this account the eastern bank of the Malakoff or North Bloomfield Mine would not be worked under the proposals now made, as the average values are too low to pay under the new conditions. There are two layers of clay each over 20 feet thick and there is also considerable sandy material. This eliminates from consideration all the gravel at the eastern end of the pit estimated at 86,700,000 cubic yards and leaves 799,900,000 to be considered. There is clay and sand at the western end of this area at Badger Hill, but prospecting operations indicate that gold in the gravel is sufficient to sweeten the average up to 10 cents. The general average from the western bank of the Bloomfield Hydraulic or Malakoff Pit to the far western end at Badger Hill is expected to yield from 9 to 12 cents per cubic yard along the middle of the channel.

Rate of Work Possible.

At this point it is well to call attention to the fact that this enormous bulk of material that can only be worked at a moderate rate. So that although 800,000,000 cubic yards is available it will not be possible to work more than one-eighth of it in the first 20 years under the plan now proposed.

The water available for work by the River Mines Company that owns most of the ground is about 1,300,000 miner's inch days per season. To this must be added "way water" or water picked up on the way down the ridge. Further supplies could be developed from the Middle Yuba but would require considerable capital. This might be done after the available supplies are fully utilized, which would take several years to accomplish, but for the first 20 years I have taken an average of 1,300,000 M. I. D. as the available water supply. With the best methods and with grades of 4½ per cent in the sluice boxes, a duty of 5 may be maintained on this gravel, but as a matter of caution, 4 has been used for these estimates, i.e. 4 cubic yards of gravel washed per miner's inch day of water.

This gives 1,300,000 x 4=5,200,000 cubic yards as the bulk of material that could be washed per season. At this rate 800,000,000 cubic yards would take over 150 years to exhaust. Therefore, it is no use to talk volubly of the enormous amount available, or of the $72,000,000 to $96,000,000 in gold that it is expected to produce. For the present it is sufficient to make plans for mining a portion of this area with the facilities that are within reach, calculating for 20 years immediately succeeding the erection of a dam at the Narrows, on the Main Yuba. The plan first considered required 3 dams, one on the Middle Yuba near Freeman's Bridge, another on the South Yuba near Norton's Cañon and a third at Shady Creek, (Jones Bar), after that at Norton's Cañon has been almost filled. The preliminary estimates of costs given in Table II, page 16, showed that this plan was far too costly.

In 20 years it would be possible to mine 104,000,000 cubic yards and produce from $9,360,000 to $12,480,000. It would take several years to attain this rate of work. The ditches and flumes at the headwaters carry about 5500 miner's inches and would have to be enlarged to carry the full amount of water available.* Thus, there would be a period of several years during which work would be on a smaller scale, increasing as more water became available and as the hydraulic mine pits were developed to utilize it. New tunnels and sluices would be required to carry the gravel, and hydraulic pits would have to be opened at the heads of these tunnels. The gravel mined would increase until it exceeded 5,200,000 cubic yards per season. The total for 20 years would probably be 104,000,000 and the gold output $10,400,000.

Gravel Available and Values in the West Bank of Bloomfield Hydraulic Mine.

At the east end of the ground described we have the mine known as the Malakoff, North Bloomfield or Bloomfield Hydraulic. The latter is the correct name. It has already been explained that it would not pay to work the eastern end of this pit under the new conditions because of clay and tuff in the bank of gravel which reduced the value per cubic yard. After 1878 all mining proceeded eastward as the bedrock rises going east, and the western bank ran out of grade. The western bank was washed through what was known as No. 8 shaft on the line of the Humbug Tunnel and the mine is called No. 8 in the reports of Hamilton Smith, Jr., General Manager for the North Bloomfield Company. This tunnel was completed in 1874 and a raise put up to surface. The gravel was washed through this, mostly surface and middle gravel for the first year, next year a little bottom gravel as well, and the third year 1876-77, bedrock was well exposed and the mine was worked both to the east and west. The effect of the richer bottom gravel is shown by the higher returns. Next year there was no work westwards as they had run out of grade. In 1877 the bottom 65 feet of gravel was washed separately from the top 200 feet, and yardage was computed from surveys with the following results:**

Top gravel 1,591,730 cubic yards yielding 3.8 cents per cu. yd.

Bottom gravel 702,200 cubic yards yielding 32.9 cents per cu. yd.

The annual reports of W. Hamilton Smith, General Manager of the North Bloomfield Company, are the best statistics of the work of any company that operated on a river leading to the Grand Valley of California. From them and from other data Mr. Waggoner prepared the following table which shows that in nine years 26,619,571 cubic yards yielded $2,611,800.17 or a rate of 9.81 cents per cubic yard.

---

*In 1876 Mr. J. D. Hague reported that 1,500,000 M.I.D. were actually delivered to mines by the ditches on this ridge.

***See* Hydraulic Mining by Bowie, p. 74.

Statement of Yield from North Bloomfield Mine.

Year	M.I.D. water used	Duty, cubic yards per M.I.D.	Yardage	Yield	
				Value	Per cubic yard
1875	465,822	*4.8	2,235,946	$ 83,078 63	$0.0272
1876	786,200	*4.17	3,278,454	200,366 54	.0611
1877	597,000	*3.86	2,304,420	291,125 42	.126
1878	796,499	*3.7	2,947,046	311,276 70	.106
1879	919,008	†3.6	3,308,429	331,759 76	.10
1880	945,550	†3.6	3,403,980	287,924 18	.085
1881	744,600	†3.6	2,680,560	236,935 14	.088
1882	988,250	†3.6	3,557,700	386,146 23	.108
1883-1884	806,399	†3.6	2,903,036	483,187 57	.166
Totals	7,049,328	3.77	26,619,571	$2,611,800 17	$0.0981

*Determined by survey.
†Assumed approximately same as previous work.
In 1881 mine suspended for 4 months by injunction.
Last line, 1883 to 1884, is to February 1, 1884, when closed by permanent injunction.
During 1870-1874, 3,250,000 cubic yards of top and side gravel were washed from various places yielding $96,700, making the total yield $2,829,869.59 or 9.1 cents per cubic yard.

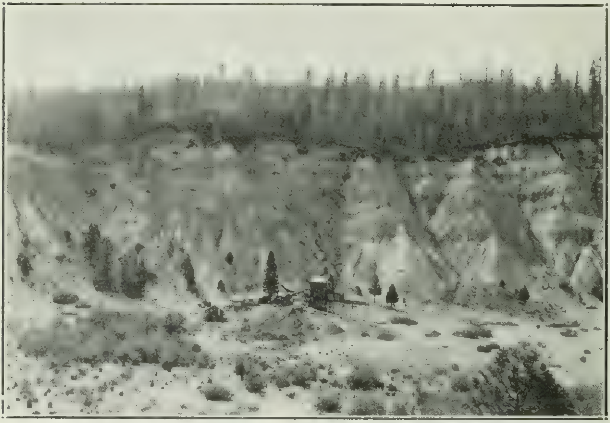


Photo by Arthur Jarman.

MALAKOFF, OR BLOOMFIELD HYDRAULIC MINE.

Debris from this mine will be restrained by a dam at the Narrows on the main Yuba. This mine yielded at the rate of 9.8 cents per cubic yard for nine years before injunctions were issued, see table printed above.

The low returns of the first two years were due to the large proportion of top gravel washed in the process of opening the pit. The higher return of the third year shows the effect of including bottom gravel when working on bedrock both east and west. The continuation of this gravel westward is assured and the estimates of quantity are based on survey data recorded by Mr. Waggoner.

In assigning a value to this material I have assumed a continuance of the value 9.8 cents because there has been no testing by prospect shafts to the west of this bank. If there had been, it is a question whether the results would more truly represent the value of the next fifty millions of cubic yards that it is intended to work in twenty years than the yield from washing 26,600,00 cubic yards. As a matter of precaution new ground should be tested by washing gravel excavated from test pits or sampling shafts. In this case no sampling has been done and the gravel is calculated at 10 cents in estimating the output on the South Yuba. Much rim gravel was washed in former work, but even so the values obtained averaged 9.1 cents per cubic yard. In future, selective mining will be used, operations being confined to the center of the channel, thus leaving low grade rim gravels untouched. Working in this way the engineers of the River Mines Company expect yields of 10 cents per cubic yard.

The contour of the bedrock shown by Mr. Waggoner in his map of this ground shows a slight increase in grade going west to Lake City. This, together with the junction of a channel coming in from the north, would favor increase in values as the work on this bank proceeds westwards.

Before opening the Bloomfield Mine, four prospect shafts were sunk to determine the position of the channel, and 1200 feet of drifting was done to test the value of the ground. No shafts have been sunk to prove the ground that it is proposed to work to the west, but the run of the channel is known because of drift tunnels and washing that has uncovered the bedrock at several places between here and Lake City. Towards the north, a covering of andesite masks the surface of the gravel, but it has been eroded through at sufficient places to allow an estimate of the probable gravel available. The gravel behind the face of this hydraulic pit is deep and there is over 50,000,000 cubic yards in a section of ground examined by me, less than 150 acres in area. From this bank to Lake City if the channel maintains the same shape as it has every indication of doing, the quantity of gravel would be over 150,000,000 cubic yards.

Mr. Waggoner has computed it as 172,000,000 to 195,000,000. From the main pit of the Bloomfield Hydraulic the amount excavated was 29,000,000 as given in Ex. Doc. 267, p. 84, but since that time another 11,000,000 was worked and the debris was stored in the pit itself, the water flowing over a debris dam and down the tunnel to Humbug Creek. The pit therefore represents an excavation of 40,000,000 cubic yards, less 11,000,000 stored in it and the 50,000,000 cubic yards of new gravel mentioned above would constitute a mine greater than that already excavated.

The Malakoff shaft was sunk to bedrock in 1922 and for a depth of 110 feet it showed 71 cents per cubic yard. This is close to the bank of gravel which is to be worked. No. 1 shaft was sunk 207 feet and the bottom 135 feet showed 41 cents per cubic yard.

Method of Attack.

To work this block of gravel it would be necessary to drive a new tunnel 4800 feet long in a northerly direction from the mouth of Humbug tunnel. This would give 4½ per cent grade to the bottom of the channel. A shorter branch tunnel might be driven from the present tunnel, but this would not serve for long. In any case tunneling is necessary to enable systematic mining to continue, and it would be done while the dam is being built.

Humbug Creek discharges into the South Yuba about 1½ miles above the damsite called Norton's Cañon, and about 15 miles above the damsite at Shady Creek, or Jones Bar. Because of the large amount of storage needed for this Lake City-Bloomfield gravel the plan first contemplated required a dam at Norton's Cañon built to a height of 290 feet, giving 68,000,000 cubic yards of storage and before 20 years elapsed a second dam wauld have been needed at the lower site at Jones Bar. Preliminary estimates from surveys in 1926 have shown that storage can be obtained more reasonably at the Narrows on the Main Yuba River, see Table II, page 16.

A study of the contour map shows that it would be feasible to attack other portions of this gravel from the South Yuba side if subsequent developments warrant doing so, but the western end at Badger Hill would be attacked from the Middle Yuba side.

Yield Expected.

Using half the water available on this ridge, 650,000 M. I. D., a duty of 4 would give 2,600,000 cubic yards for the average season's work. This at 10 cents would produce $260,000.

Other Mines in the Bloomfield-Lake City Area.

In addition to the Bloomfield there were several other diggings or mines that produced gold from this vicinity all sending their debris to the South Yuba: the Brockmeyer, Paine diggings, Sherwood diggings, Dutch Boys diggings. It is improbable that there will be enough water to enable these diggings to be worked as separate concerns until the industry has had time to establish itself.

Just west of Lake City, and about 2 miles west of the Bloomfield Hydraulic Mine is the Union Hydraulic Pit. This discharged debris into Spring Creek, which empties into the South Yuba about five miles below Humbug Creek. Further west there begins a continuous series of mine pits that extend from North Columbia to Badger Hill. The first of these was known as the Consolidated Mine, as it was a consolidation of many small claims. This and the Union Hydraulic both drained into Spring Creek and in all probability future working would be done by sending the debris into the South Yuba.

Other Mines That Discharge Into the South Yuba.

SAILOR FLAT AND BLUE TENT.

An enormous quantity has been worked here, estimated at 15,000,000 cubic yards (see Doc. 267, pp. 84 and 89) and a very large amount remains, given as 30,000,000 to 60,000,000 cubic yards but there are many reasons which combine to make it improbable that any of this will be touched except a small amount of bottom gravel on the Blue Tent ground. The bedrock dips away from the river making it difficult to follow up with rockcuts and drainage tunnels and the main banks are remarkable in showing a large proportion of tuffs, fine sand and grit which would not be expected to be gold bearing. This material washed easily giving a duty said to be 10 cubic yards to the miner's inch of water. The proportion of true hydraulic gravel below this is probably small. It is not visible, being covered by slides of material from above. Work had already been carried up to the cover of andesite and this would further reduce the value of the returns.

Larson's estimate for the gravel workable at Sailor Flat is 4,840,000 cubic yards* it being limited to this amount because of the large amount of barren material in the banks.

At the Blue Tent (Gopher Hill Pit) there is some bottom gravel partly occupied by the ruins of the old town and this looks to be good hydraulic gravel. This bank varies up to 160 feet high and contains over 2,000,000 cubic yards. Behind this, at the Enterprise Mine a considerable amount of work was done on material similar to that at Sailor Flat.

W. H. Pettee in Whitney (p. 414) says that 632,533 cubic yards washed in 1876-77 yielded 12.6 cents per cubic yard at Gopher Hill. In 1878, 501,028 cubic yards yielded 14 cents to the cubic yard at Gopher Hill. In the same year at the "Blue Lead" (same company's ground) 235,703 cubic yards yielded 7 cents per cubic yard. At the Enterprise pit of the same company 1,398,963 cubic yards of fine loose sandy material was washed in 1876-77 for a yield of 2.06 cents per cubic yard, barely enough to cover expenses.

Relief Hill.

About three miles east of North Bloomfield, on the North Bank of the South Yuba, is Relief Hill where 6,000,000 cubic yards is estimated as having been washed and from 5,000,000 to 15,000,000 available. Owners of ground here estimate there is 30,000,000 cubic yards available to the southwest and west of the old workings. A duty of 3 to 4 was easily obtained as there was plenty of grade. There are two ditches that give a short local water season of 1200 miner's inches. Some extra water can be purchased from the Bloomfield Company's ditch. Ex. Doc. No. 267, p. 88, says that the Eureka Lake Company's holdings here did not pay. The other ground was worked for many years by a group of miners with success, though the returns are not known. After being enjoined they continued to work illegally from time to time.

After injunctions considerable drifting was done. Exact returns are not known but are reported as $30,000 to $40,000 per year (see Lindgren p. 140). The gravel appears to have the general character of that at Omega and at Bloomfield, and should produce 9 to 13 cents per cubic yard where not drifted. The owners expect very much higher results. The bulk of the debris could be retained in the cañon and only the fines need be sent down the river.

Rate of Work Possible.

1200 M. I. for 4 months=about 120,000 M. I. D. for the season. With a duty of 3½ this would treat 420,000 cubic yards. At 9 cents per cubic yard this would yield $37,800.

If results equal to this be obtained, this ground would pay for the development of a water supply to prolong the season.

---

*See Ex. Doc. 98, pp. 108 and 109.

WASHINGTON.

Four miles further up the river there is a flat of unworked secondary gravel on the south side of the river, which is being prospected by the Washington Mining and Development Company. There is about 120 acres covered by gravel 35 feet deep or more. This has been tested by four shafts, which showed from 8 to 18 feet of bouldery gravel at the bottom, and ordinary river gravel above. The latter carried 8 to 12 cents per cubic yard and the bouldery gravel was richer, but very variable.

When drifting, a test on 46 carloads showed that the bottom gravel carried $1.42 per cubic yard before discarding the boulders. 69 carloads from another portion of the property showed $2.28 per cubic yard. A shallow gravel like this can be hydraulicked with good profit, but being alongside the river a dam must be provided on the river itself at some place lower down as at Norton's Cañon. The company has water rights on Scotchman's Creek and a ditch that conveys water used for ground sluicing. This can readily be made to carry 800 miner's inches.

Rate of Work and Yield Expected.

800 x 26 x 7=145,600 M. I. D. This gives 145,600 cubic yards for the season. Half of this at 15 cents and half at 50 cents would give $47,320 for the season. The richer gravel on the bedrock and the gold from crevices in the bedrock may augment this figure considerably, but with these secondary gravels it is impossible to forecast what may be obtained owing to their spotty nature.

OMEGA.

This mine is about nine miles in a direct line east of North Bloomfield and is on the south side of the river. From it can be seen Alpha and other points where gravel has been worked, then Relief Hill and behind that, Bloomfield, these places marking the track of the old river that laid down these gravels. Omega is well known as having gravel that gave good profits, it being easy to move and regular in gold contents, averaging 13½ cents for the whole bank. About 13,000,000 cubic yards have been mined and an additional 24,000,000 may be mined before the overburden of andesite will give trouble. If the gravel maintains its previous record for regularity of returns the whole of this will pay under the new conditions. The company possesses its own ditch that brings 5000 miner's inches from the South Yuba, also another ditch bringing 1200 miner's inches from Diamond Creek. The latter has been renewed this year and the former is being repaired. There is about nine miles of timber fluming (6 ft. x 4 ft.) alongside the river at the head of the larger ditch.

5000 M. I. for 6 months of 26 piping days=780,000 M. I. D.
1200 M. I. for 4 months of 26 piping days=124,800 M. I. D.

Total water for season..................904,800 M. I. D.

In 1880 these ditches supplied a total of 358,000 M. I. D. With a duty of 3 this would treat 1,074,000 cubic yards for the season. At 13 cents this would yield $139,620. These are the figures used in Table on p. 71.

This rate of work would soon be attained if the ditches are cleaned out after the timber fluming has been repaired. About 3 miles of this fluming was repaired this summer ready to hydraulic. The figures indicate that the rate of work done in 1880 may be exceeded.

Mines That Would Discharge Into the Middle Yuba.

At the west end of the area described on p. 72, there were several mines that discharged into Shady Creek and its tributaries. This creek joins the South Yuba about 10 miles below Spring Creek. It has not sufficient fall to clear itself from the large amount of debris discharged into it and this very materially delayed work in the mines above.

A tunnel 12,000 feet long could be driven to tap these gravels from the South Yuba and give good grade, but 7,800 feet of driving would do the same work from Grizzly Creek, a tributary of Middle Yuba. Two shorter tunnels could also be driven from Grizzly Creek to tap the Patterson gravels. Therefore, a dam site was surveyed near Freeman's Bridge on the Middle Yuba for gravels between North Columbia and Paterson's or Badger Hill.

The site for the dam is a good one and gives impounding capacity more reasonably than any other site on the Middle Yuba. An alternative site was examined below Emory Ford or Emory Flat. A dam there would catch this gravel but the rock at the site is heavily jointed. Therefore, it is preferable to go four miles lower down to Freeman's where there is not this disadvantage, and where storage would be developed at less cost.*

The gravel that would be washed from this western end was formerly worked by a number of mines known as the Central, Consolidated, Eureka Lake, Laird, Farrel, Western, McCarty's, Patterson, Badger Hill.

The quantity of gravel remaining is readily calculated from the contours of the gravel surface and the contours of the bedrock in which it lies.

Leaving rim gravel out of account I calculated 442,000,000 cubic yards here that will be readily accessible when tunnels are driven from Grizzley Creek. Mr. Waggoner in a detailed examination estimated that 627,000,000 cubic yards are available. Mr. C. H. Munro indicates that attention would be chiefly directed to the central portion of the channel that he estimates contains 275,000,000 cubic yards.

The gravel already worked from these areas was top gravel, most of it light and not of great value; bedrock has not been reached, except at Badger Hill. Records of production are fragmentary as there has been no obligation imposed on owners to record their returns.

---

* Written before estimates of costs were obtained for dams on these sites and before agreement was reached for storage in the proposed dam at the Narrows on the Main Yuba River.

Table of Yields.

Mines	Cubic yards	Value per cubic yard	Yield	Year	Cost of water per M.I.D.
William Weigel	4,320,800	$0.06 to $0.08	$345,663 10	1865–1868	$0 25
McCartys	3,000,000	.0433	129,904 53		20
Grey's Diggins			(22,288)		
Eureka Lake Company		.041		1875	20
Consolidated	1,110,000	.031	35,776 72	1881	
Farrel	1,922,000	.050	96,115 52	1881	
Laird	1,120,000	.034	38,645 30	1881	
Consolidated	1,970,000	.044	86,800 00	1884	
Laird	346,000	.031	10,700 00	1884	
Totals	13,788,800		$743,605 17		
Average		$0.0535			

The table of yields given is compiled chiefly from data given in Mr. Hague's report. This shows a range of value from 3.1 to 8 cents and an average of 5.35. This was top gravel easily moved like that washed at North Bloomfield, Dutch Flat, You Bet and Gold Run, and similar to those other gravels in being of low value.

One shaft was sunk on the Consolidated ground. This showed a depth of 237 feet of gravel remaining and that it was originally 500 feet deep. Some drifting was done to determine the run of the channel which was found to be 600 feet wide (see Ex. Doc. 267, p. 88). The values from this work are not on record. A few miles further east the work done at North Bloomfield in 1887 showed that 1,591,730 cubic yards of gravel from the top 200 feet on the mine yielded 3.8 cents per cubic yard, and 702,200 cubic yards from the bottom 65 feet yielded 32.9 cents per cubic yard. The average for the 265 feet was 12.7 cents per cubic yard.

With yields of from 3.1 to 8 cents for the top gravel of the Columbia deposit we may reasonably expect something of the order of 9 to 12 cents from the gravel that lies below, at any rate in the central portion of the 627,000,000 cubic yards of gravel that remains. It is well to recall the general average of 9.8 cents obtained from 26,000,000 cubic yards mined at Bloomfield. Before work is commenced on this area it is probable that several trial shafts would be sunk to determine whether one portion of the ground is appreciably different from the rest. The expense of renovating the ditches and refitting the mines and for tunnelling would be considerable and if one portion of the gravel is richer than the rest it would be well to work that ground as early as possible.

Mr. C. H. Munro, Consulting Engineer for the River Mines Company, who has had extensive experience in hydraulic and dredge mining, has made a careful study and valuation of this deposit between North Bloomfield and Badger Hill. He writes as follows under dates of January 7 and January 31, 1927:

"The total length of channel considered is about 34,000 feet. The extensive drill prospecting work, coupled with mining operations, indicates 18,000 feet of channel, or 275,000,000 cubic yards, with an average recovery value of 10.5c per cubic yard, on the western portion."

"On the eastern, or North Bloomfield end, 5200 feet of channel have been worked to bedrock, with an average recovery of 9.06c for 29,870,000 cubic yards. Previous to the completion of the North Bloomfield bedrock tunnel short tunnels were run at elevations higher than the bottom of the channel to mine off the top gravels. In some places these top gravels were mined to a width of 4800 feet. A large area of low grade ground was taken from the north and south rims in this area, which would otherwise not have been mined if the bedrock tunnel had been completed earlier. In future it will not be necessary to mine to the width as shown in the North Bloomfield pit but by selective mining or confining the operations to the pay channel a better recovery per cubic yard should be obtained than was secured from the former mining operations. It is, therefore, reasonable to assume that the eastern portion of the channel from the east end of the drilled area to the Malakoff pit, a distance of 16,000 feet, should give an average recovery of 10c per cubic yard for a total of 133,000,000 cubic yards."

"Summarizing the above figures, we have available selective yardage as follows:

San Juan Channel	*Length*	*Cubic yards*	*Recovery value, cents*	*Total value*
Western portion	18,000 ft.	275,000,000	10.5	$28,875,000
Eastern portion	16,000 ft.	133,000,000	10.0	13,300,000
Totals and averages	34,000 ft.	408,000,000	10.3	$42,175,000

"When you consider the extent of drilling development over the 34,000 feet of channel and also that 5200 feet were mined to bedrock on the eastern end, the conclusions arrived at above are fair and reasonable."

"As soon as it is definitely decided that tailing storage space can be secured at a low cost, it is the intention of the River Mines Company to equip their large hydraulic property of San Juan Ridge for active mining operations."

At the above value, hydraulic mining would pay if the impounding is cheap and if the miner is assured that he may continue to mine upon complying with the regulations of the Commission.

With the assurance that there will be an adequate dam on the south and on the Middle Yuba it would pay to drive all the tunnels mentioned and to renovate ditches and flumes and refit the mines on this area. But unless there is the security that such work may be prosecuted regularly for many seasons it would be futile to expend the capital required. To recover this capital and earn interest upon it it will necessitate many years of work.

Rate of Work Possible.

On the Middle Yuba side of the ridge there would be available the other half of the water distributable by ditches belonging to the River Mines Company, viz:—650,000 M. I. D. for the year, plus "way water". The Consolidated, Farrel, and Laird diggings used 903,522 M. I. D. in 1881 according to Hague's report.

Additional water could be obtained from the Middle Yuba by excavating a ditch, but the cost would be large. Many ditch companies organized in the old days spent much money and were unable to return their capital to the shareholders; therefore, water that would entail building an entirely new ditch of considerable length is not included in this estimate. "Way water" will help considerably, however.

The duty obtainable on gravels at this end of the North Columbia deposit would be about the same as that obtained at the eastern end, viz, 4 cubic yards or more per miner's inch. 650,000 x 4 gives 2,600,000 cubic yards for the season. The same yardage would be obtained if some water from these ditches were diverted for work at Moore's Flat, Snow Point, or North San Juan, the only difference being that some of the gravel would be mined at these other places.

The above is a conservative estimate because "way water" or water picked up on the way would be considerable on the long run of ditches from Lake Bowman to the mines.

With a yearly yardage of 2,600,000 it will take a long time to work the gravel known to be available. It is, therefore, probable that means will be found for developing additional water and the above rate of work may be largely exceeded. In the meantime 2,600,000 cubic yards per annum is my estimate of what will be done provided that assistance be given through the erection of a large dam.

Other Districts on the Middle Yuba.

At Moore's Flat, the Blue Bank and Boston Mines worked their way well into the bank until they had to contend with a heavy cover of andesite. This finally came down as a large landslide and stopped hydraulic operations by smothering the rock cuts and boxes. To work behind this slide would necessitate sluicing away sufficient material to uncover the rock cuts and it is a matter of opinion whether this would pay. The Blue Bank was rich, and miners have assured me that it would pay to work, but I have not included it in the table of gravels available.

Water for work at Moore's Flat was drawn from ditches that supply water for the main area at North Columbia, viz, the River Mines Company ditches.

The yields for 1881 from Snow Point and Boston Mines were given by Mr. Hague as follows: Snow Point $27,387.24, giving $6,635.55 profit. At 4.9 yards to the M. I. D. this worked out at 11.3 cents per cubic yard and a cost of 8.5 cents. Boston yielded $140,407.39 giving $81,705.14 profit at 4.9 yards per M. I. D.; this gives 14.5 cents per cubic yard and a cost of 6.9 cents.

Some small areas of gravel are known on the Middle Yuba and its tributaries, and will be workable if a dam is provided at Freeman's for the North Columbia gravels. I did not examine them as they are widely separated.

ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Personnel.

Mr. E. A. Lowe of San Francisco has been appointed to the position of Librarian of the Bureau, vice Wm. E. Dolton, resigned.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Bulletin No. 97. 'California Mineral Production for 1925,' by Walter W. Bradley. 172 pages, illustrated with 9 half-tones and 10 line-cuts (maps and charts). Distributed without charge.

Summary of Operations, California Oil Fields, Vol. 12, Nos. 2 and 3 for August and September, 1926, respectively.

Commercial Mineral Notes: Nos. 45, 46, 47, November, 1926-January, 1927, (inc.). These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale' issued in the form of a mimeographed sheet monthly. It is mailed free to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains in addition to its correspondence file and the library, a mine report file which includes reports on some 7,500 mines and mineral properties in California.

During the period covered by this quarterly report, there were 1497 letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Deputy State Mineralogist.

CALIFORNIA'S MINERAL PRODUCTION IN 1926 MAINTAINS ADVANCE.

Estimate of 1926 Output.

The total value of the mineral production of California for the year 1926, just closed, is conservatively estimated by the statistical division of the State Mining Bureau to have been approximately $456,408,000. This is, in part, detailed in the tabulation below; but, as there are more than fifty mineral substances on California's commercial list, it is impracticable at this early date to obtain definite figures on other than the more important items. The blank report forms are being mailed to the operators in all mineral lines, and the date of publication of the final detailed and complete report will depend upon the promptness of their replies.

The estimated total of $456,408,000 is an increase of approximately $24,000,000 over the 1925 production, which in turn surpassed the previous record value of the year 1924. This increase is due mainly to petroleum, and in part also to cement and other structural materials. Although there was a decrease of approximately 8,000,000 barrels in the quantity of crude oil, the total value is higher by around $25,000,000, owing to an advance in prices effective from March 11, 1926, and continuing throughout the year. Approximately 85% of the crude oil at present produced in California is above 20° Baumé, some of it testing as high as 50° B.; while the low-grade oil ranges down to 9° B. Current prices (January, 1926) range from 75c per barrel for 14°-20° crude in the San Joaquin Valley fields to $2.74 for 43° crude in the Athens-Rosecrans-Dominguez group.

Receipts of bullion at the mint and smelters show a decrease in gold yield of about $1,400,000 compared with 1925, the drop being chargeable to both lode mines and placers (except dredges, which maintained practically their same level). The drop in silver was due to closing the California Rand Silver mine and to decreased copper-ore shipments. The lesser copper output was due to Shasta County mainly, but in part to Plumas County. There was a slight increase in lead-ore shipments and about 50% increase in zinc, the latter including Shasta County and Santa Catalina Island. Although quicksilver prices advanced materially during 1926, closing the year at $99 per flask, there was a decrease in the quantity produced, owing to closing down of the New Almaden and Cloverdale mines.

As building continued active throughout 1926, nearly all items of the structural group will show increased quantities and total values, especially cement, crushed rock, sand and gravel. Magnesite shipments decreased, due partly to maintenance of foreign importations and lower prices. There were no notable changes reported in the general status of the miscellaneous 'industrial' group nor among the salines.

The estimated quantities and values for 1926 are as follows

$11,700,000	gold.
1,195,000	(1,920,000 fine oz.) silver.
4,400,000	(31,600,000 lb.) copper.
643,000	(7,750,000 lb.) lead.
1,202,000	(16,350,000 lb.) zinc.
540,000	(6,200 flasks) quicksilver.
25,000	(230 fine oz.) platinum.
360,000	other metals, including antimony, iron, manganese, tungsten.
355,000,000	(224,335,000 bbl.) petroleum.
16,000,000	(190,000,000 M. cu. ft.) natural gas.
27,000,000	(14,200,000 bbl.) cement.
17,500,000	crushed rock, sand and gravel.
7,500,000	brick and hollow building tile.
543,000	(47,000 tons, crude) magnesite.
3,000,000	other structural materials, including granite, et al.
5,500,000	miscellaneous 'industrial' minerals.
4,300,000	salines, including borates, potash, salt, et al.
$456,408,000	Total value.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

FRANK SANBORN, Mineral Technologist.

Diamonds have been known to occur in California for many years; in fact, it was very soon after the discovery of gold that an article appeared in the American Journal of Science, published in September, 1849, mentioning the finding of a diamond in California. The sources or mode of occurrence of these diamonds are as yet unknown. Undoubtedly only a few of these precious stones passing through the sluice-boxes of the placer mines have been recovered, as but few systematic attempts to search for diamonds during gold-sluicing operations have been made.

A few months ago a small diamond was uncovered in this laboratory from a sample of black sand submitted from Siskiyou County. It was requested that this sample be tested for metals of the platinum group, and it was while concentrating the sample for subsequent treatment that the small gem was discovered. The suggestion was made to the sender of the sample that a diamond grease-board might prove to be of value, or at least interesting during the sluice-box clean-up.

Diamonds are heavy, having a specific gravity of 3.52; consequently, they will gather in the sluices or concentrate in the gold-pan. If these concentrates are passed over a board that has been coated with mutton tallow, the diamonds will adhere to the tallowed board while the other material passes over it. The tallowed board should be "jigged" or vibrated in such a way that the sand and gravel will work off, leaving any diamonds adhering to the tallow.

During the three-month period covered by this report, 1105 samples were received and determined at the Bureau's laboratory.

LIBRARY.

E. A. LOWE, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

- Annual Report of the Director to the Secretary of the Interior for the Fiscal Year ending June 30, 1926.
- Bulletin 784—Bibliography of North American Geology for 1923–24. By John M. Nickles.
- Bulletin 785–C—Borate Deposits in the Kramer District, Kern County, California. B. L. F. Noble.
- Bulletin 785–D—Note on a Colmanite Deposit near Shoshone, Cal., with a Sketch of the Geology of a part of Amargosa Valley. By L. F. Noble.
- Bulletin 786–A—The Geology of the Ingomar Anticline, Treasure and Rosebud Counties, Montana. By K. C. Heald.
- Bulletin 788–A—Topographic Instructions of the United States Geological Survey. By H. M. Frye.
- Bulletin 788–B—Topographic Instructions of the United States Geological Survey. B. Triangulation. By E. M. Douglas.
- Bulletin 788–C—Topographic Instructions of the United States Geological Survey. C. Transit Traverse. By E. M. Douglas.
- Bulletin 788–D—Topographic Instructions of the United States Geological Survey. D. Leveling. By E. M. Douglas.
- Bulletin 790–A—Pedestal Rocks Formed by Differential Erosion and Channel Erosion of the Rio Salado Socorro County, New Mexico. By Kirk Bryan.
- Bulletin 790–B—The "Palouse Soil" Problem with an Account of Elephant Remains in Wind-borne Soil on the Columbia Plateau of Washington. By Kirk Bryan.
- Professional Paper 147–C—American Tertiary Mullusks of the Genus Clementia. By W. P. Woodring.

Professional Paper 137—The Fauna of the Ripley Formation on Coon Creek, Tennessee. By Bruce Wade.

Water Supply Paper 530—Surface Water Supply of the United States, 1921, Part X, The Great Basin. Prepared in cooperation with the states of Idaho, Utah, Nevada, California and Oregon. By Nathan C. Grover.

Water Supply Paper 553—Surface Water Supply of the United States, 1922, Part XII, North Pacific Slope Drainage Basins. By Nathan C. Grover.

Water Supply Paper 554—Surface Water Supply of the United States, 1922, Part XII, North Pacific Slope Drainage Basins. By Nathan C. Grover.

Water Supply Paper 555—Surface Water Supply of Hawaii, July 1, 1921, to June 30, 1922. By N. C. Grover.

Water Supply Paper 559—Relations between Quality of Water and Industrial Development in the United States. By W. D. Collins.

Water Supply Paper 564—Surface Water Supply of the United States. By Nathan C. Grover.

Water Supply Paper 565—Surface Water Supply of the United States, 1923, Part V, Hudson Bay and Upper Mississippi River Basins.

Water Supply Paper 580–B—Water Power and Irrigation in the Jefferson River Basin, Montana. By John F. Deed and Walter N. White.

Water Supply Paper 592—Surface Water Supply of the United States in 1924, Part XII, North Pacific Slope Drainage Basins. By Nathan C. Grover.

U. S. Bureau of Mines:

Bulletin 243—Diamond Drilling with Special Reference to Oil-Field Prospecting and Development.

Bulletin 249—Manual of Testing Methods for Oil Shale and Shale Oil.

Bulletin 250—Oil Field Emulsions.

Bulletin 254—Smoke-Abatement Investigation at Salt Lake City, Utah.

Bulletin 255—Investigation of the Preparation and Use of Lignite, 1918–1925.

Bulletin 258—Suggestions for the Design of Electrical Accessories for Permissible Mining Equipment.

Bulletin 264—Metal-Mine Accidents in the United States, 1924.

Technical Paper 303—Utilization of Manganiferous Iron Ores. By T. L. Joseph, P. H. Royster and S. P. Kinney.

Technical Paper 379—Strength of Ore and Top Rock in Red Iron-Ore Mines of the Birmingham District, Alabama. By W. R. Crane.

Technical Paper 390—Occurrence, Distribution, and Significance of Alkali Cyanides in the Iron Blast Furnace. By S. P. Kinney and E. W. Guernsey.

Technical Paper 392—Accidents in the Petroleum Industry of Oklahoma, 1915–1924. By H. C. Fowler.

Technical Paper 396—Low Temperature Carbonization of Coal. By A. C. Fieldner.

Technical Paper 397—Composition of Materials from Various Elevations in an Iron Blast Furnace. By S. P. Kinney.

Technical Paper 400—Accidents Due to Explosives in Metal Mines of the Southwest as Shown by Records in Arizona. By E. D. Gardner.

Technical Paper 402—Safety Rules for Installing and Using Electrical Equipment in Coal Mines, Sponsored by the U. S. Bureau of Mines and American Mining Congress.

Technical Paper 406—Production of Explosives in the United States During the Calendar Year 1925.

Technical Paper 408—Coke Oven Accidents in the United States During Calendar Year 1925. By William W. Adams.

Mineral Resources of the United States:

Salt, Bromine, and Calcium Chloride in 1925. By A. T. Coons.

Secondary Metals in 1925. By J. P. Dunlop.

Lime in 1925. By A. T. Coons.

Natural Gas in 1925. By G. R. Hopkins.

Phosphate Rock in 1925. By W. M. Weigel and B. H. Stoddard.

Platinum and Allied Metals in 1925. By James M. Hill.

Tin in 1925. By J. R. Furness.

Iron Ore, Pig Iron and Steel in 1925. By Hubert W. Davis.

Chromite in 1925. By J. W. Furness.

Lead and Zinc Pigments and Salts in 1925. By J. A. Stader and A. Stoll.

Manganese and Manganiferous Ores in 1925. By J. W. Furness.

Lead in 1925. Smelter Report. By J. A. Stader and A. Stoll.
Gold, Silver, and Copper in South Dakota and Wyoming in 1925. By Charles W. Henderson.
Gold, Silver, and Copper in South Dakota and Wyoming in 1924. By C. W. Henderson.
Gold, Silver, Copper, Lead, and Zinc in Colorado in 1924. By C. W. Henderson.
Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas in 1924. By C. W. Henderson.
Mercury in 1925. By J. W. Furness.
Asphalt and Related Bitumens in 1925. By G. R. Hopkins and A. B. Coons.
Feldspar in 1925. By Jefferson Middleton.
Graphite in 1925. By Jefferson Middleton.
Carbon Black Produced from Natural Gas in 1925. By G. R. Hopkins.
Asbestos in 1925. By Blanche H. Stoddard.
Slate in 1925. By A. T. Coons.
Magnesium and its Compounds in 1925. By J. M. Hill.
Barite and Barium Products in 1925. By A. Stoll and R. M. Sautmyer.
Clay in 1925. By Jefferson Middleton.
Gypsum in 1925. By Jefferson Middleton.
Abrasive Materials in 1925. By Frank J. Katz.
Mica in 1925. By W. M. Myers and Blanche H. Stoddard.
Natural Gas-Gasoline in 1925. By G. R. Hopkins.
Talc and Soapstone in 1925. By Blanche H. Stoddard.
Arsenic in 1925. By V. C. Heikes.
Bauxite and Aluminum in 1925. By James M. Hill.
Gold, Silver, Copper, Lead, and Zinc in the Eastern States in 1925. By J. P. Dunlop.
Petroleum in 1924. By G. B. Richardson and A. B. Coons.
Antimony in 1925. By J. W. Furness.
Annual Report of the Director of the Bureau of Mines, year ending June 30, 1926.
Publications of the Bureau of Mines, July, 1926.
Index of Bureau of Mines Publications.
Bureau of Mines Safety Labels. By L. C. Ilsley.

Reports of Investigations.

Serial No. 2789—Charging Explosives in Drill Holes of Drift Rounds in Metal Mines. By E. D. Gardner.
Serial No. 2790—The Blasting of Hanging Ore Columns in Chutes and Drawing Raises. By E. D. Gardner.
Serial No. 2791—Explosives used in December, 1926, Including Preliminary Figures for the Year 1926. By W. W. Adams.
Serial No. 2792—Coal Mine Fatalities in December, 1926, and Preliminary Figures for the Year 1926. By W. W. Adams.

Information Circulars.

Circular No. 6015—The Motor Fuel Situation. By A. J. Kraemer.
Circular No. 6016—Survey of Petroleum Pipe Lines and Storage Capacity for Crude Oil and Refined Products. By G. R. Hopkins and A. B. Coons.
Circular No. 6017—Railroad Fuel Oil Consumption. By E. B. Swanson.
Circular No. 6018—The Tin Situation from a Domestic Standpoint. By J. W. Furness.
Circular No. 6019—Consumption of Tin in the United States, 1925. By J. W. Furness.

U. S. Army: Annual Report of the Chief of Engineers, Parts 1 and 2, 1926.
Director of the Mint: Annual Report for 1926. The Production of the Precious Metals.
U. S. Coast and Geodetic Survey: Seismological Report, July, August, September, 1925.

Alabama Geological Survey:

Report of Progress, 1923–26. By Eugene Allen Smith, Ph.D.
Special Report No. 14, 1926. The Geology of Alabama. By G. I. Adams, C. Butts, L. W. Stephenson, and W. Cooks.

- Idaho Bureau of Mines and Geology:
  - Geology and Ore Deposits of Boundary County, Idaho. By Virgil R. D. Kukham and Ernest W. Ellis.
  - Ground Water for Municipal Supply at St. Maries, Idaho. By Virgil R. D. Kukham.

- Illinois State Geological Survey:
  - List of Publications on the Geology of Illinois with Appended Index.
  - Illinois Petroleum. No. 6. Dec. 4, 1926.
- Kansas State Inspector of Oils: Annual Report to the Governor of Kansas.
- Kentucky Geological Survey: Series No. VI. Pamphlet No. XI. A Bibliography of the several Books, Reports, Papers, and Maps by Willard Rouse Jillson.

- Minnesota Chats:
  - Vol. 7. No. 92. October, 1926.
  - Vol. 7. No. 93.
- Missouri Bureau of Geology and Mines: Vol. XIX, Second Series. The Geology of Vernon County.
- Nevada State Inspector of Mines: Biennial Report, 1925–26. By A. J. Stinson.
- New York Public Library: New Technical Books. Vol. II, No. 3.
- North Carolina Department of Conservation and Development:
  - Biennial Report of the Director, 1925–26. By Wade H. Phillips.
  - Economic Paper No. 57. The Economic Development of the Furniture Industry of the South and Its Future Dependence Upon Forestry. By C. F. Korstian.

- Oklahoma Geological Survey:
  - Circular 9—The Sycamore Limestone. By C. L. Cooper.
  - Circular 13—The Permian of Western Oklahoma and the Panhandle of Texas. By Chas. N. Gould and Frank E. Lewis.
  - Bulletin 41—The Upper Paleozoic Rocks of Oklahoma.
- West Virginia Geological Survey: Mercer, Monroe and Summers. By David B. Reger and Paul H. Price.
- California Bureau of Labor Statistics: Twenty-second Biennial Report, 1925–26. By Walter G. Mathewson.
- California Fish and Game Commission: Twenty-ninth Biennial Report, 1924–26.
- California Industrial Accident Commission: Report, July 1, 1925, to June 30, 1926.
- California State Library: Vol. 21, No. 4, October, 1926. News Notes of California Libraries. Annual Statistics.
- Argentina Republica, Direccion General de Minas, Geologia, e Hidrologia:
  - Publicacion 17—Sobre el Contenido de Azufre-en-el Yeso de Transicion de la Sierra de Vaca Muerta. By L. R. Catalano.
  - Publicacion 18—La Presencia del niquel en algunos petroleos, Rafaelita y el supuesto carbon de Malarque. By H. Corti.
  - Publicacion 19—Los Hoyos del Campo Cielo y el Meteorito. By J. J. Nagera.
  - Publicacion 20—Informe Sobre las posibilidades existentes para el Aprovisionamiento de aqua en Puerto Camarones. By Anselmo Winhausen.
  - Publicacion 21—
    - I. Sobre las Minas de Cobra de Famatina.
    - II. Establecimiento Metalurgico de Sta. Florentina. By N. A. Lannefors y S. Wassman.
  - Publicacion 22—Yacimientos Cao Knicos del Valle de los Sauces. By L. R. Catalano.

- Australian Institute of Mining and Metallurgy:
  - Proceedings Nos. 60 and 61.
  - Proceeding 62, New Series. June 30, 1926.
  - Proceeding 63, New Series, September 30, 1926.

- Australian Museum:
  - Records, Vol. XV, No. 2.
  - Records, Vol. XV, No. 3.
  - Records, Vol. XIV, No. 5.

- Canada Department of Mines:
  - Report for the Fiscal Year Ending March 31, 1926.

Biological Series No. 12—Nov. 9, 1926. List of Quarternary and Tertiary Diatomageal from Deposits of South Canada. By C. S. Boyes.
  Memoir 149, No. 130 Geological Series—Placer and Vein Gold in Deposits of Barkerville, Cariboo District, British Columbia. By W. A. Johnston and W. L. Uglow.
Memoir 150, No. 131 Geological Series—Whitehorse District, Yukon. By W. E. Cockfield and A. H. Bell.
  Investigations in Ceramics and Road Materials, 1925.
  Investigations in Ore Dressing and Metallurgy, 1925.
  Investigations of Mineral Resources and the Mining Industry, 1925.
  Bituminous Sands of Northern Alberta, with Map Folio. By S. C. Ells.
  Sodium Sulphate in Western Canada. By L. H. Cole.

Canadian Institute of Mining and Metallurgy:
  Bulletin 175, November, 1926.
  Bulletin 176.

Great Britain Geological Survey:
  Vol. V—Special Report on the Mineral Resources of Great Britain. Iron Ores—the Hæmatities of the Forest of Dean and South Wales.
  The Geology of the Country near Lewes. By H. J. O. White.
Manchuria Geological and Mining Review: No. 67, Dec. 1, 1926. Dr. H. Murakami and B. Toheida.

Mexico Secretaria de Industria, Comercio y Trabajo:
  Boletin del Petroleo, Vol. XXII, No. 4. Tallares Graficos de la Nacion Mexico, 1926.
  Boletin del Petroleo, Vol. XXII, No. 5.
  Boletin del Petroleo, Vol. XXII. No. 6.
  Boletin Minero. Tomo XXII, No. 4, October, 1926.
  Annuario de Estadistica Minera, 1924.
  Revista Mensarel de las Actividades Petroleras En Mexico, 1926.
  Estados Unidos Mexicanos Estradistica Nacional.
New Zealand Department of Mines: Palæontological Bulletin 11—The Cretaceous and Tertiary Foraminifera of New Zealand. By F. Chapman.

Ontario Department of Mines:
  Bulletin 58—Metal Production of Ontario for 9 Months of 1926. By W. R. Rogers and A. C. Young.
  November Gold Bulletin.
  Thirty-fifth Annual Report, Vol. XXXV, Part IV, 1925. By G. Vibert Douglas.
  Thirty-fifth Annual Report, Vol. XXXV, Part V to VIII. By R. B. Harkness.
  Thirty-fifth Annual Report, Vol. XXXV, Part III, 1926.

Philippine Journal of Science:
  Vol. 31, No. 1, September, 1926.
  Vol. 31, No. 3, November, 1926.
  Vol. 31, No. 4, December, 1926.
Poland, Legation of: Production of Minerals, January 10, 1927.
Rio de Janiero: Archivos Museu Nacional, Vol. XXVI.
South Australia Department of Mines: Mining Review, No. 44, Half Year Ending June 30, 1926. By Hon. A. A. Kirkpatrick, M. L. C.
South Manchuria: The Geology and Mineral Resources of.
Transvaal Chamber of Mines: Notice of Ordinary Meeting.
Uraguay Instituto de Geologia y Perforaciones Montevideo: Boletin 8a—Julio de 1926. Nota sobre el pisco de Itarare y los sedimentos marinos del Rincon de Alonso. Pro. E. Terra Arocena.

Societies and Educational Institutions.

American Geographical Society:
  The Geographical Review, Vol. XVI, 1926.
  The Geographical Review, January, 1927.

Alabama, University of:
  Bulletin 31—Analyses of Alabama Coals. By Charles Butts.
  Bulletin 28—Index to the Mineral Resources of Alabama. By Walter B. Jones, Ph. D.

California, University of:

Skull and Skeletal Remains of a Ruminant of the Preptoceras-Euceratherium Group. By Chester Stock and E. L. Furlong.

Geology of the La Jolla Quadrangle, California. By Marcus A. Hanna.

Publications in Geological Sciences, Vol. XV, 1924–1926. By A. C. Lawson, and G. D. Louderback.

Publications in Geological Sciences, Vol. XVI, No. 5. The Domengine Horizone Middle Eocene of California. By B. L. Clark.

Publications in Geological Sciences, Vol. XVI, No. 6. Geology of Point Sur Quadrangle, California. By P. D. Trask.

Chile American Association, New York, 1926: Mutual Trade and Resources of Chile and the United States.

Missouri, University of, School of Mines and Metallurgy: Bulletin, 1927, Vol. 19, No. 2.

Penn State College Engineering Experiment Station, The: Bulletin 35—The Tangent Method of Analysis for Indicator Cards of Internal Combustion Engines. By P. H. Schweitzer.

Washington, University of, Engineering Experiment Station: Bulletin 18—The Clays and Shales of Washington, their Technology and Uses. By Hewitt Wilson.

Western Pennsylvania, Engineers' Society of: Proceedings, Vol. 42, No. 7, October, 1926.

American Philosophical Society, Proceedings for Promoting Useful Knowledge, Vol. LXV, 1926, No. 4.

Institute of Mining and Metallurgy, Transactions of: 34th Session, 1924–25, Vol. XXXIV, Part 1.

Institution of Mining and Metallurgy.

Bulletin 266—November, 1926.
Bulletin 267—December, 1926.
Bulletin 268—January, 1927.

Mining and Metallurgy Society of America:

Bulletin 187—January, 1927, Vol. XX, No. 1.
Bulletin 185.
Bulletin 186.

Mineralogical Society of America:

The American Mineralogist, Vol. 11, No. 12. Walter F. Hunt, Editor.

The American Mineralogist, Vol. 12, No. 2, February, 1927.

Society of Chemical Industry: Recent Developments in the Formation of Synthetic Fuel from Carbon Monoxide and Hydrogen.

Rensselaer Polytechnic Institute: No. 13, An Investigation of the Physical Properties of some Nickel-Iron Alloys of the Invar Group. By Eric Anders Blomquist.

Smithsonian Institute:

Annual Report, 1925.

Report on the International Exchange Service, 1926.

Western Society of Engineers: Journal, October, 1926; Vol. XXXI, No. 10.

Library of Congress:

Report for 1926.

Monthly Check List of State Publications, Vol. 17, No. 6.

State Publications Received during September, 1926. Vol. 17, No. 9.

State Publications Received during September, 1926. Vol. 19, No. 11, November, 1926.

California Academy of Sciences:

Proceedings, Vol. II, Part 1, 1913–17.
Proceedings, Vol. II, Part 2, 1918–26.
Proceedings, Vol. XIV, 1924.
Proceedings, Vol. XVI, No. 1.
Proceedings, Vol. XVI, No. 2.
Proceedings, Vol. XVI, No. 3.
Proceedings, Vol. XVI, No. 4.

Economic Geology Series No. 2: Talc Deposits of Canada. By M. E. Wilson.
Vol. XXI. No. 7, November, 1926.
Vol. XXI, No. 8, December, 1926.
Vol. XXII, January-February, 1927, No. 1

Books.

Pictorial History of the Lassen Volcano. By B. F. Loomis.

Maps.

Topographic Maps:
Burbank, California.
Corcoran, California.
Guernsey, California.
Lake View School, California.
Lindsay, California.
Tipton, California.
Waukena, California.
Westhaven, California.
Woodville, California.
Goshen, California.
Beardstown, Illinois.
Black River Falls, Wisconsin.
Brookville, Pennsylvania.
Fraser, Colorado.
Harrisburg, West Virginia.
Island Pond, Vermont.
Littleton, West Virginia-Pennsylvania.
McHenry, Illinois-Wisconsin.
McMinnville, Oregon.
Lethent, California.
Altadena, California.
La Habra, California.
Reseda, California.
Glendale, California.
Los Angeles, California.
Claremont, California.
La Verne, California.
La Crescenta, California.
Hanford, California.
Van Nuys, California.
Mt. Lowe, California.
Topango Canyon, California.
Puente, California.
Sierra Madre, California.
San Pedro Hills, California.
Azusa, California.
Lemon Cove, California.
Montezuma, Colorado.
Morattico, Virginia.
New Matamoras, Ohio-West Virginia.
Oregon, Missouri-Kansas.
Pittsfield, Illinois.
St. Joseph, Missouri-Kansas.
Tuscaloosa, Alabama.
Tuscumbia, Alabama.
Wauzeka, Wisconsin.
Wellsville, New York.
West Union, West Virginia.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Bulletin, Union Oil Co., Los Angeles.
California Journal of Development, San Francisco.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical-Engineering and Mining Review, Melbourne, Australia.
Engineering and Mining Journal-Press, New York.
Explosives Engineer, Wilmington, Del.
Financial Insurance News, Los Angeles, California.
Graphite, Jersey City.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mine and Quarry, Chicago.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil and Gas News, Kansas City.
Oil News, Galesburg, Illinois.

Oildom, New York.
Oil. Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, San Francisco, Cal.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of Mining in California was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of Mining in California, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'

EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

51–1 Examination and consulting work.

51–2 Store or cost accountant. Two and one-half years as clerk, correspondent and private secretary. Age 26. Married. References. Salary open.

51–3 Assayer or foreman. Assayer and superintendent various properties in South Dakota, Colorado, Montana, Alaska and Nevada. Age 59. Married. References. Salary open.

51–4 Mining or metallurgy, preferably in foreign country. University training in mining and metallurgy. Twelve years' experience in Alaska, California and Nevada. Speaks some French. Age 30. Married, but can travel. References. Salary open.

◆

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper	----
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties. 136 pp., paper	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916. Fletcher Hamilton. 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County. 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton: 562 pp., 71 illustrations, cloth	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz counties	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial counties	.25
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25
October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties	.25
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1925	Free
January, February, March, April, May, June, July, August, September, 1926	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	$0.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps	.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905. 168 pp., 54 illustrations	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905. 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	$0.25
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring, 1918. 248 pp., 51 illustrations, 5 maps, paper	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley, 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth	1.00
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916–1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917–1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	----
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth	1.00

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.	Price
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	$1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley, 1923, 188 pp., paper	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley, 1924. 162 pp., paper	Free
Bulletin No. 95. Geology and Ore Deposits of the Randsburg Quadrangle, by Carlton D. Hulin, 1925. 152 pp., 49 photographs, 13 line cuts, 1 colored geologic map, cloth	2.00
Bulletin No. 96. California Mineral Production for 1924, by Walter W. Bradley, 1925. 173 pp., paper	Free
Bulletin No. 97. California Mineral Production for 1925, by Walter W. Bradley, 1926. 172 pp., paper	Free

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	Free
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS.

Register of Mines With Maps.

Asterisks (**) indicate out of print.

	Price
**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County (1906)	$0.25
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County (1905)	.25
Register of Oil Wells, with Map, Los Angeles City (1906)	.35

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California, Showing Mineral Deposits (50 x 60 in.)	----
**Map of Forest Reserves in California	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	----
**Map of Trinity County	----
**Map of Tuolumne County	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
**Geographical Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	----
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

	Price
Map No. 1—Sargent, Santa Clara County	$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emido and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.25
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	.75
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	.75
Map No. 32—Seal Beach, Los Angeles and Orange Counties	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

50727 5-27 2650

THE STATE MINING BUREAU

CORDIALLY INVITES YOU TO VISIT ITS VARIOUS DEPARTMENTS MAINTAINED FOR THE PURPOSE OF FURTHERING THE DEVELOPMENT OF THE

MINERAL RESOURCES OF CALIFORNIA

At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the State Mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily.
Saturday, 9 a.m. to 12 m.

LLOYD L. ROOT,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.

Branch Offices: New Orpheum Building, Los Angeles; Chamber of Commerce Building (mail address, P. O. Box 1208), Sacramento; Bank of Italy Building, Bakersfield; Taft, Coalinga, Santa Maria, and Santa Paula.

CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT State Mineralogist

San Francisco] BULLETIN No. 97 [September, 1926

CALIFORNIA MINERAL PRODUCTION FOR 1925

By

WALTER W. BRADLEY

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1926

47818

CONTENTS.

Page
LETTER OF TRANSMITTAL 7
INTRODUCTION 9

Chapter I.

SUMMARY OF THE MINERAL INDUSTRY IN CALIFORNIA DURING THE YEAR OF 1925 11
  Tabulation of the Mineral Production Showing Comparative Amounts and Values—1924 and 1925 12
  Table Showing Comparative Mineral Production of the Various Counties in California for 1924 and 1925 13
  Total Production, 1887-1925 14

Chapter II.

FUELS (HYDROCARBONS)—

  Introductory 15
  Coal 15
  Natural Gas 16
  Petroleum 20

Chapter III.

METALS—

  Introductory 34
  Aluminum 35
  Antimony 35
  Arsenic 37
  Beryllium 38
  Bismuth 38
  Cadmium 39
  Cobalt 39
  Copper 40
  Gold 43
  Iridium. (*See* Platinum.)
  Iron 47
  Lead 47
  Manganese 49
  Molybdenum 50
  Nickel 51
  Osmium 51
  Palladium 51
  Platinum 51
  Quicksilver 53
  Silver 55
  Tin 57
  Tungsten 58
  Vanadium 60
  Zinc 60

Chapter IV.

STRUCTURAL MATERIALS—

  Introductory 62
  Asphalt 63
  Bituminous Rock 63
  Brick and Hollow Tile 64
  Cement 67
  Chromite 68
  Granite 70

CHAPTER IV—Continued.

STRUCTURAL MATERIALS—Continued.

PAGE
LIME ---- 73
MAGNESITE ---- 74
MARBLE ---- 79
ONYX AND TRAVERTINE ---- 79
SANDSTONE ---- 80
SERPENTINE ---- 81
SLATE ---- 81
STONE—MISCELLANEOUS ---- 83
  Paving Blocks ---- 84
  Grinding Mill Pebbles ---- 84
  Sand and Gravel ---- 85
  Crushed Rock ---- 86

CHAPTER V.

INDUSTRIAL MATERIALS—

INTRODUCTORY ---- 90
ASBESTOS ---- 91
BARYTES ---- 93
CLAY—POTTERY ---- 94
DOLOMITE ---- 96
FELDSPAR ---- 97
FLUORSPAR ---- 98
FULLER'S EARTH ---- 99
GEMS ---- 100
GRAPHITE ---- 102
GYPSUM ---- 103
INFUSORIAL AND DIATOMACEOUS EARTHS ---- 105
LIMESTONE ---- 107
LITHIA ---- 108
MICA ---- 108
MINERAL PAINT ---- 109
MINERAL WATER ---- 110
PHOSPHATES ---- 111
PUMICE AND VOLCANIC ASH ---- 111
PYRITES ---- 112
SHALE OIL ---- 113
SILICA—SAND AND QUARTZ ---- 114
SILLIMANITE—ANDALUSITE—CYANITE GROUP ---- 115
SOAPSTONE AND TALC ---- 116
STRONTIUM ---- 118
SULPHUR ---- 118

CHAPTER VI.

SALINES—

INTRODUCTORY ---- 120
BORATES ---- 120
CALCIUM CHLORIDE ---- 122
MAGNESIUM SALTS ---- 124
NITRATES ---- 124
POTASH ---- 125
SALT ---- 126
SODA ---- 127

CHAPTER VII.

MINERAL PRODUCTION OF CALIFORNIA BY COUNTIES—

INTRODUCTORY ---- 128
ALAMEDA ---- 129
ALPINE ---- 129
AMADOR ---- 129
BUTTE ---- 130

Chapter VII—Continued.

MINERAL PRODUCTION OF CALIFORNIA BY COUNTIES—Continued. Page

Calaveras ---- 130
Colusa ---- 131
Contra Costa ---- 131
Del Norte ---- 131
El Dorado ---- 132
Fresno ---- 132
Glenn ---- 133
Humboldt ---- 133
Imperial ---- 134
Inyo ---- 134
Kern ---- 135
Kings ---- 135
Lake ---- 136
Lassen ---- 136
Los Angeles ---- 136
Madera ---- 137
Marin ---- 137
Mariposa ---- 138
Mendocino ---- 138
Merced ---- 138
Modoc ---- 139
Mono ---- 139
Monterey ---- 139
Napa ---- 140
Nevada ---- 140
Orange ---- 141
Placer ---- 141
Plumas ---- 142
Riverside ---- 142
Sacramento ---- 143
San Benito ---- 143
San Bernardino ---- 144
San Diego ---- 144
San Francisco ---- 145
San Joaquin ---- 145
San Luis Obispo ---- 146
San Mateo ---- 146
Santa Barbara ---- 146
Santa Clara ---- 147
Santa Cruz ---- 147
Shasta ---- 148
Sierra ---- 148
Siskiyou ---- 149
Solano ---- 149
Sonoma ---- 149
Stanislaus ---- 150
Sutter ---- 150
Tehama ---- 151
Trinity ---- 151
Tulare ---- 151
Tuolumne ---- 152
Ventura ---- 152
Yolo ---- 153
Yuba ---- 153

APPENDIX.

MINING BUREAU ACT ---- 154
PUBLICATIONS OF THE STATE MINING BUREAU ---- 157
INDEX ---- 167

ILLUSTRATIONS.

PAGE

Lorenz Hydraulic Mine, near Weaverville, Trinity County ---- 43

P. & H. Gasoline Steam-Shovel and Pierce Gravel Gold-Washing Machine on Jenkins & Taylor Placer near French Gulch, Shasta County ---- 45

Concentrating Plant of California Zinc Company at Winthrop, Shasta County ---- 61

Plant of Santa Cruz Portland Cement Company, Davenport, Santa Cruz County. Airplane photo ---- 66

El Dorado County Slate Placed on Roof of a Residence Being Built in Oakland, California ---- 82

Plant of Granite Rock Company at Logan, San Benito County ---- 85

Asbestos Fiberizing Mill of the San Benito Asbestos Company, San Benito County 91

Gypsum Deposit of Pacific Portland Cement Company in the Fish Mountains, Imperial County ---- 104

Three-Hundred-Ton Plaster Mill of Pacific Portland Cement Company at Plaster City, Imperial County ---- 104

MAPS AND CHARTS.

Graph Showing Annual Value and Increase of Mineral Production of California from 1890 to 1924 ---- 14

Monthly Production and Utilization of Natural Gas in Southern California ---- 18

Monthly Production of Casing-Head Gas in the California Oil Fields ---- 18

Outline Map of California Showing Location of Oil Fields and Districts ---- 27

Current Trend of World Production of Major Non-Ferrous Metals ---- 36

Prices of Electrolytic Copper, Wire Bars, Ingot Bars and Cakes F. O. B. Eastern Seaboard Refinery, Cents per Pound ---- 40

Prices of Common Lead, Desilverized and Soft Missouri, at New York City, Cents per Pound ---- 48

Prices of Bar Silver Bullion, 999 Fine at New York City, Cents per Troy Ounces 56

Prices of Slab Zinc, Prime Western Brands, at St. Louis, Missouri, Cents per Pound ---- 60

Prices of Canadian Asbestos "Crude" and "Fiber," F. O. B. Quebec, 1922-1925 -- 92

LETTER OF TRANSMITTAL.

September, 1926.

To His Excellency, The Honorable Friend Wm. Richardson,
Governor of the State of California.

Sir: I have the honor to herewith transmit Bulletin No. 97 of the State Mining Bureau, being the annual report of the statistics of the mineral production of California.

The remarkable variety, total valuation, and wide distribution of many of our minerals revealed herein show California's importance as a producer of commercial minerals among the states of the Union.

Respectfully submitted.

Lloyd L. Root,
State Mineralogist.

INTRODUCTION.

It is the endeavor of the staff of the State Mining Bureau, in these annual reports of the mineral industries of California, to so compile the statistics of production that they will be of actual use to producers and to those interested in the utilization of the mineral products of our state, while at the same time keeping the individual's data confidential. In addition to the mere figures of output, we have included descriptions of the uses and characteristics of many of the materials, as well as a brief mention of their occurrences.

The compilation of accurate and dependable figures is an extremely difficult undertaking, and the State Mineralogist takes the opportunity of here expressing his appreciation of the cooperation of the producers in making this work possible. A fuller appreciation of the value of early responses to the requests sent out in January will result in earlier completion of the manuscript. Statistics lose much of their value if their publication is unnecessarily delayed.

Some of the data relative to properties and uses of many of the minerals herein described are repeated from preceding reports, as it is intended that this annual statistical bulletin shall be somewhat of a compendium of information on California's commercial minerals and their utilization.

Lloyd L. Root,
State Mineralogist.

MINERAL INDUSTRY, CALIFORNIA, 1925.

DATA COMPILED FROM DIRECT RETURNS FROM PRODUCERS IN ANSWER TO INQUIRIES SENT OUT BY THE CALIFORNIA STATE MINING BUREAU, FERRY BUILDING, SAN FRANCISCO, CALIFORNIA.

CHAPTER ONE.

The total value of the mineral output of California for the year 1925 was $434,519,660, being an increase of $59,898,871 over the 1924 total of $374,620,789. There were fifty-five different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the fifty-eight counties of the state contributed to the list.

As revealed by the data following, the salient features of 1925 compared with the preceding year were: The considerable increase in value of the petroleum yield. Material advances were also made by cement, miscellaneous stone, zinc, lead, and quicksilver; while decreases were registered by brick and hollow building blocks and by salt. Gold, copper, silver, and pottery clay fairly well held their own with only slight drops in total value. There were a number of other minor variations. The net result was an increase in the grand total for all groups of practically sixty million dollars, as stated above. Petroleum accounted for an increase of $55,956,955 in total value, due both to advanced prices and an increase from 228,933,471 barrels to 232,492,147 barrels in quantity, or a difference of 3,558,676 barrels.

Of the metals: lead increased from 4,984,387 pounds, worth $398,751, to 7,352,422 pounds, worth $639,661; zinc from 3,060,000 pounds and $198,000 to 11,546,602 pounds and $877,542; quicksilver from 7,948 flasks and $543,080 to 7,683 flasks and $621,831; platinum from 273 fine ounces and $36,452 to 292 fine ounces and $39,937. Though gold decreased slightly, California continues to account for approximately 30 per cent of the gold output of the United States.

Of the structural group: cement advanced from 11,655,131 barrels, worth $23,225,850, to 13,206,630 barrels, worth $25,043,335; granite from a valuation of $1,211,046 to $1,853,859. Brick and hollow building blocks or tile decreased in total value from $9,137,908 to $7,503,976, due mainly to common brick, though all classes showed drops except fire-brick which advanced slightly in value for a slightly smaller quantity. Lime and magnesite both dropped off slightly. Of the 'industrial' group, as is usually the case, there were a number of fluctuations, mineral water and the sillimanite group being the only ones to show material increases. Of the salines, calcium chloride, potash, and soda increased in value, with the borates, magnesium salts, and common salt decreasing.

The figures of the State Mining Bureau are made up from reports received direct from the producers of the various minerals. Care is exercised in avoiding duplication, and any error is likely to be on the side of under- rather than over-estimation.

California yields commercially a greater number and variety of mineral products than any state in the United States, and probably more than any other equal area elsewhere of the earth. The total annual value of her output has been surpassed by not more than four or five others, and those usually the great coal states of east of the Mississippi. The past two years, California has been second only to Pennsylvania. California was for many years the sole domestic source of borax, chromite and magnesite and in which we still lead. We lead all other states in the production of gold, quicksilver, and platinum; and have alternated in the lead with Colorado in tungsten, and with Oklahoma in petroleum.

By Substances.

The following table shows the comparative yield of mineral substances of California for 1924 and 1925, as compiled from the returns received at the State Mining Bureau, San Francisco, in answer to inquiries sent to producers:

Substance	1924		1925		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Asbestos	70 tons	$4,750	*	*	* —
Bituminous rock	6,040 tons	14,922	*	*	* —
Borates	52,070 tons	1,599,149	46,124 tons	$1,526,938	$72,211—
Brick and hollow building tile		9,137,908		7,503,976	1,633,932—
Cement	11,655,131 bbls.	23,225,850	13,206,630 bbls.	25,043,335	1,817,485+
Chromite	350 tons	6,700	591 tons	10,912	4,212+
Clay (pottery)	417,928 tons	651,857	537,587 tons	674,376	22,519+
Coal	1,425 tons	8,800	730 tons	3,880	4,920—
Copper	52,089,349 lbs.	6,823,704	46,968,499 lbs.	6,669,527	154,177—
Dolomite	28,843 tons	71,271	42,852 tons	104,900	33,629+
Feldspar	9,055 tons	68,112	8,165 tons	59,615	8,497—
Fuller's earth	5,290 tons	67,295	5,280 tons	91,842	24,547+
Gems		4,800		10,663	5,863+
Gold		13,150,175		13,065,330	84,845—
Granite		1,211,046		1,853,859	642,813+
Gypsum	25,569 tons	53,210	107,613 tons	172,444	119,234+
Lead	4,984,387 lbs.	398,751	7,352,422 lbs.	639,661	240,910+
Lime	62,029 tons	703,355	61,922 tons	685,528	17,827—
Limestone	219,476 tons	582,660	319,977 tons	494,525	88,135—
Lithia	109 tons	2,269			2,269—
Magnesite	67,236 tons	900,183	64,623 tons	872,944	27,239—
Magnesium salts	4,823 tons	145,883	4,221 tons	132,553	13,330—
Manganese ore	1,115 tons	25,785	832 tons	19,450	6,335—
Marble	[a]61,579 cu. ft.	140,253	35,664 cu. ft.	116,105	24,148—
Mineral paint	532 tons	5,234	669 tons	6,969	1,735+
Mineral water	8,159,211 gals.	818,726	12,115,072 gals.	1,230,455	411,729+
Natural gas	209,921,596 M cu. ft.	15,153,140	194,719,924 M cu. ft.	15,890,082	736,942+
Onyx and travertine	[b]		19,940 cu. ft.	16,120	16,120+
Petroleum	228,933,471 bbls.	274,652,874	232,492,147 bbls.	330,609,829	55,956,955+
Platinum	273 fine oz.	36,452	292 fine oz.	39,937	3,485+
Potash	33,107 tons	747,407	36,355 tons	829,770	82,363+
Pumice and volcanic ash	4,919 tons	33,404	5,319 tons	32,937	467—
Pyrites	124,214 tons	517,835	129,500 tons	528,550	10,715+
Quicksilver	7,948 flasks	543,080	7,683 flasks	621,831	78,751+
Salt	318,800 tons	1,159,137	284,068 tons	949,826	209,311—
Sandstone	6,700 cu. ft.	3,600	14,704 cu. ft.	14,362	10,762+
Silica (sand and quartz)	6,808 tons	35,006	12,498 tons	96,780	61,774+
Silver	3,555,153 fine oz.	2,381,952	3,054,416 fine oz.	2,119,765	262,187—
Soapstone and talc	16,179 tons	242,770	15,465 tons	239,084	3,686—
Soda	32,536 tons	711,796	48,625 tons	947,649	235,853+
Stone, miscellaneous [c]		15,966,380		17,409,854	1,443,474+
Tungsten concentrates	781 tons	446,009	573 tons	348,471	97,538—
Zinc	3,060,000 lbs.	198,900	11,546,602 lbs.	877,542	678,642+
Unapportioned		[d]1,968,399		[e]1,957,484	10,915—
Total values		$374,620,789		$434,519,660	
Net increase					$59,898,871+

*Under 'unapportioned.'

[a] Includes onyx and travertine.

[b] Combined with marble.

[c] Includes macadam, ballast, rubble, riprap, paving blocks, sand, gravel, and grinding-mill pebbles.

[d] Includes calcium chloride, diatomaceous earth, iron ore, shale oil, sillimanite-andalusite, sulphur, aluminum sulphate, glauber salt, potash alum, mica schist, radio galena crystals, arsenic.

[e] Includes calcium chloride, bituminous rock, antimony, asbestos, graphite, infusorial and diatomaceous earth, iron ore, shale oil sillimanite-andalusite.

By Counties.

The following table shows the comparative value of the mineral production of the various counties in the state, for the years 1924 and 1925:

County.	*1924*	*1925*
Alameda	$2,634,645	$2,916,506
Alpine	2,552	520
Amador	2,938,865	2,625,703
Butte	641,750	546,178
Calaveras	1,572,419	1,450,618
Colusa	77,267	103,230
Contra Costa	2,348,090	2,544,179
Del Norte	722,265	270,582
El Dorado	395,572	352,828
Fresno	12,547,798	9,264,996
Glenn	41,550	92,288
Humboldt	485,478	719,151
Imperial	139,908	330,965
Inyo	2,110.075	2,585,145
Kern	74,164,451	89,400,726
Kings	725	520
Lake	96,396	73,348
Lassen	37,908	2,404
Los Angeles	168,420,709	193,180,000
Madera	955,469	1,377,458
Marin	527,231	434,802
Mariposa	234,707	634,862
Mendocino	60,768	16,533
Merced	87,603	80,262
Modoc	1,300	2,400
Mono	126,691	184,745
Monterey	286,490	277,721
Napa	359,265	229,172
Nevada	2,945,267	2,352,877
Orange	40,481,210	49.104,490
Placer	492,180	550,413
Plumas	3,876,105	4,401,508
Riverside	5,508,244	5,179,108
Sacramento	2,196,210	2,504,405
San Benito	2,144,603	2,617,396
San Bernardino	12,642,431	14,179,663
San Diego	1,013,119	1,129,757
San Francisco	150,258	131,158
San Joaquin	602,500	737,818
San Luis Obispo	317,779	136,477
San Mateo	302,171	1,577,513
Santa Barbara	5.159,740	4,338,431
Santa Clara	1,150.401	1,320,858
Santa Cruz	4,339,233	3,227,036
Shasta	4,754,664	4,300,449
Sierra	812,476	1,386,301
Siskiyou	140,787	219,626
Solano	3,089,475	2,678,547
Sonoma	172,051	160,231
Stanislaus	345,138	415,466
Sutter	97	397
Tehama	34,454	77,183
Trinity	509,344	502,289
Tulare	498,674	426,979
Tuolumne	629,156	567,248
Ventura	6,089,394	17,853,540
Yolo	15,800	23,060
Yuba	2,189,881	2,721,594
Total values	$374,620,789	$434,519,660

Total Mineral Production of California, by Years.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau began. At the side of these figures the writer has placed the values of the most important metal and non-metal items—gold and petroleum.

In the same period copper made an important growth beginning with 1897 following the entry of the Shasta County mines, and more recently Plumas County. Cement increased rapidly from 1902, while crushed rock, sand and gravel as a group parallels the cement increase. Quicksilver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. War-time increases, 1915–1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc. Most of these, except silver, have since declined; though structural materials and copper increased in 1920–1924, also lead and magnesite in 1923; lead and zinc in 1925.

Total Mineral Production of California, by Years, Since 1887.

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,614	$1,357,144
1888	19,469,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	[illegible]	[illegible]	384,200
1891	[illegible]	[illegible]	[illegible]
1892	[illegible]	[illegible]	[illegible]
1893	[illegible]	12,422,811	608,092
1894	20,203,294	13,923,281	[illegible]
1895	22,844,663	15,334,317	[illegible]
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	[illegible]	[illegible]
1899	29,313,460	[illegible]	[illegible]
1900	32,622,945	[illegible]	[illegible]
1901	34,355,981	[illegible]	2,961,102
1902	35,069,105	[illegible]	[illegible]
1903	37,759,040	[illegible]	[illegible]
1904	43,778,348	[illegible]	[illegible]
1905	43,069,227	[illegible]	[illegible]
1906	46,776,085	[illegible]	[illegible]
1907	55,697,949	[illegible]	[illegible]
1908	66,363,198	[illegible]	[illegible]
1909	82,972,209	[illegible]	32,398,187
1910	[illegible]	[illegible]	[illegible]
1911	[illegible]	[illegible]	[illegible]
1912	[illegible]	[illegible]	[illegible]
1913	[illegible]	[illegible]	[illegible]
1914	93,314,773	[illegible]	47,487,109
1915	96,663,369	[illegible]	[illegible]
1916	127,901,610	[illegible]	[illegible]
1917	161,202,962	[illegible]	[illegible]
1918	199,753,837	16,529,162	[illegible]
1919	195,830,002	[illegible]	[illegible]
1920	242,099,667	14,311,043	178,394,937
1921	268,157,472	15,704,822	203,138,225
1922	245,183,826	14,670,346	[illegible]
1923	344,024,678	13,379,013	[illegible]
1924	374,620,789	13,150,175	[illegible]
1925	434,519,660	13,065,330	330,609,829
Total values	$3,904,915,476	$641,813,072	$2,213,747,928

CHAPTER TWO.

FUELS.

Among the most important mineral products of California are its fuels. This subdivision includes coal, natural gas, and petroleum, the combined values of which made up practically 80 per cent of the state's entire mineral output for the year 1925.

There are deposits of peat known in several localities in California, small amounts of which are used as a fertilizer, and in stock-food preparations, but none has yet been recorded as utilized for fuel.

Comparison of values during 1924 and 1925 is shown in the following table:

	1924		1925		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Coal	1,425 tons	$8,800	730 tons	$3,880	$4,920—
Natural gas	209,921,596 M cu. ft.	15,153,140	194,719,924 M cu. ft.	15,890,082	736,942+
Petroleum	228,933,471 bbls.	274,652,874	232,492,147 bbls.	330,609,829	55,956,955+
Total value		$289,814,814		$346,503,791	
Net increase					$56,688,977+

COAL.

Bibliography: State Mineralogist Reports VII, XII–XV (inc.), XVII, XIX–XXI (inc.). U. S. Geol. Surv., Bulletins 285, 316, 431, 471, 581; Ann. Rpt. 22, Pt. III.

Coal production in California in 1925 totaled 730 short tons valued at $3,880, being credited to Amador, Mendocino, and Riverside counties. Only a small part of it was marketed, as it was mainly consumed for local camp purposes and for power and forge use in development work on the deposits. Considerable development work is under way in Shasta County, as well as in Mendocino. Experiments on a commercial scale are being made by the Pacific Gas and Electric Company with a new type of generator to produce gas from Californian coal at their Marysville gas plant. Incidentally the new method of gas making is not a return to that in use before the introduction of oil, when the coal had to be retorted 12 to 14 hours. It is stated that in the new machines coal will be transferred into gas in five minutes.

Total Coal Production of California.

The very considerable output of coal in the years previous to 1883 was almost entirely from the Mount Diablo district, Contra Costa County. Later the Tesla mine in Corral Hollow, Alameda County, was an important producer for a few years. Stone Canyon, Monterey County, was also an important producer for a short time, and there has been some coal shipped from properties in Amador, Fresno, Orange, Riverside and Siskiyou counties. The following tabulation gives the annual tonnages and values, according to available records:

Coal Output and Value by Years.

Year	Tons	Value	Year	Tons	Value
1861	6,620	$38,065	1895	79,858	$193,790
1862	23,400	134,550	1896	70,649	161,335
1863	43,200	248,400	1897	87,449	196,255
1864	50,700	291,525	1898	143,045	337,475
1865	60,530	348,048	1899	160,941	420,109
1866	84,020	483,115	1900	176,956	535,531
1867	124,690	716,968	1901	150,724	401,772
1868	143,676	826,137	1902	88,460	248,622
1869	157,234	904,096	1903	93,026	265,383
1870	141,890	815,868	1904	79,062	376,494
1871	152,493	876,835	1905	46,500	144,500
1872	190,859	1,097,439	1906	24,850	61,600
1873	186,611	1,073,013	1907	23,734	55,849
1874	215,352	1,238,274	1908	18,496	55,503
1875	166,638	958,169	1909	49,389	216,913
1876	128,049	736,282	1910	11,033	23,484
1877	107,789	619,787	1911	11,047	18,297
1878	134,237	771,863	1912	14,484	39,092
1879	147,879	850,304	1913	25,198	85,809
1880	236,950	1,362,463	1914	11,859	28,806
1881	140,000	805,000	1915	10,299	26,662
1882	112,592	647,404	1916	4,037	7,030
1883	76,162	380,810	1917	3,527	7,691
1884	77,485	309,950	1918	6,343	16,149
1885	71,615	286,460	1919	2,983	8,203
1886	100,000	300,000	1920	2,078	5,450
1887	50,000	150,000	1921	12,467	63,578
1888	95,000	380,000	1922	27,020	135,100
1889	121,280	288,232	1923	1,010	5,090
1890	110,711	283,019	1924	1,425	8,800
1891	93,301	204,902	1925	730	3,880
1892	85,178	209,711			
1893	72,603	167,555	Totals	5,207,310	$23,098,358
1894	59,887	139,862			

The tonnages in the above table for the years 1861–1886 (incl.) are taken from the U. S. Geological Survey, "Mineral Resources of the U. S., 1910," p. 107. The values assigned for the years previous to 1883 are those given by W. A. Goodyear (Mineral Res., 1882, pp. 93–94), being an average of $5.75 per ton. From 1887 to date the figures are those of the California State Mining Bureau.

NATURAL GAS.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV. Bulletins 3, 16, 19, 69, 73, 89. Monthly Summary, Oil & Gas Supervisor, Dec. 1919; Aug., 1922; Mar., 1923; Mar. and Apr., 1926.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necesssary to approximate the output of many of the operators in the oil fields, estimated on the number of lights, and on the number and horsepower of gas engines and steam boilers thus operated. The figures here given are for gas utilized locally and also that sold for distribution to consumers; and we consider are not over-estimated, particularly in the six oil-producing counties. It must be remembered that several of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable, nor is it often possible to have pipe-line facilities available to handle the gas accompanying the early gas production in newly developed fields. Wherever feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam driven plants.

The most notable gas developments in California in recent years have been in the Elk Hills and Buena Vista Hills in Kern County, northeast of the Midway district, and in the new oil fields in the Los Angeles basin, Los Angeles and Orange counties.

The following paragraphs are quoted, with accompanying charts, from a recent report by Mr. C. C. Brown,[1] gas engineer of the Railroad Commission of California, which is a continuation of the earlier report by Masser.[2]

"The oil industry is coming to realize more and more the important role which natural gas plays in the economic recovery of petroleum from the oil fields. In the past little attempt has been made to conserve the gas within the oil reservoirs, it being felt that the production or rather, the releasing, of the initial compressed gas was an unavoidable factor in oil field operation, and that the wastage of this product over and above the amount needed for field use and sale under existing contracts to gas distributing companies was not a serious economic loss.

"However, recent experiments and tests have definitely proved that the conservation of this natural gas within the oil sands is of utmost importance to the oil operator if he is to secure the maximum length of producing life and maximum total production of oil from his wells.

"As a matter of fact, gas is being reintroduced into the oil-bearing strata in a number of cases where the original gas had been dissipated and where the wells had long ceased to flow. The results achieved by this procedure have been, to some extent, encouraging.

"Another factor that has tended to emphasize the value of natural gas in the last few years is the installation of large numbers of gasoline extraction plants, through which tremendous quantities of casing-head gas are being processed for the extraction of natural gasoline.

"The natural gasoline industry has grown from a comparatively few small plants installed some twenty years ago to something over eleven hundred plants in the United States, with a capitalization of over $250,000,000, with a total daily capacity of about four and one-half million gallons. The production of natural gasoline is increasing at the rate of approximately 10 per cent a year.

* * * * * * *

"Another very tangible factor in the value of natural gas is its value as a fuel commodity. * * * In the greater portion of this territory, natural gas is utilized for domestic, commercial and industrial purposes. In the cities of Los Angeles and Santa Barbara a mixed gas is used having a heat value of 850 B.t.u. per cubic foot. This gas is produced by 'cracking' or 'reforming' natural gas and mixing it with straight natural gas having a heat value of about 1200 B.t.u.

"The 'reforming' or 'cracking' of natural gas is a process of much interest to several of the southern California gas utilities. During the major portion of the year there exists an abundance of natural gas, more than sufficient to provide for mixing requirements. In this period, the artificial gas portion of the commercial mixture may be manufactured by 'reforming' natural gas rather than by producing this gas from oil, which is vastly more efficient thermally than is the oil gas process. In addition to the economy on a heat unit basis, there is a further saving due to the somewhat lower price of natural gas as compared with oil upon an equivalent fuel value. In view of these efficiencies and economies, it has been the regular practice of the two utilities in Los Angeles since about 1917 to manufacture as much as possible of the required volume of artificial gas by reforming. This economy is, of course, recognized by the Railroad Commission, and present gas rates reflect the benefit to the consumer.

"The reforming process is carried on in the regular type of straight shot oil gas generator, without any important change whatsoever in construction. The operation of the generator is practically the same as for oil gas production, and it is therefore possible to change from oil to natural gas at any time, according to the local requirements of the natural gas supply.

"In this process the methane and ethane are partially decomposed into carbon and hydrogen, with an accompanying increase of volume and reduction in heat value per cubic foot. The extent of the decomposition of the natural gas varies with the generator temperature and the time of contact of the gas with the hot brickwork. Therefore, with constant temperatures within the normal operating range of the generator, the quality of the reformed gas made varies with the rate of introduction of natural gas into the machine; further, the capacity of the machine increases with the higher B.t.u. quality, as the natural gas is injected at a higher rate per hour to obtain a shorter period of contact with hot brickwork, and a correspondingly lesser decomposition.

"The primary decomposition of the natural gas on contact with the hot brickwork is the breaking down the ethane (C_2H_6) which is less stable chemically than methane. This is indicated by analysis of reformed gases which are entirely lacking in ethane, while methane is still present in large percentages. While ethane is the less stable of the two hydrocarbons, it requires a greater amount of heat to completely decompose it. However, the decomposition doubtless proceeds in two stages, first forming methane, which is then subject to decomposition in the same manner as the other methane originally present in the gas.

---

[1] Brown, C. C., Natural gas in California: Rep. of State Oil and Gas Sup., California State Mining Bureau, Vol. 11, No. 9, pp. 8-28. Mar. 1926.

[2] Masser, H. L., Rep. of State Oil and Gas Sup., Vol. 8 No. 9, Mar. 1923. See also Cal. State Min. Bur. Bulletin 93.

"At such times as there is not sufficient available natural gas for reforming purposes, the process of oil gas manufacture is resorted to. The oil or gas is then enriched with natural gas to bring the mixture up to the required 850 B.t.u. quality."

Production and Value.

There is rather a wide variation in prices quoted for natural gas because a considerable part is used directly in the field for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have placed a valuation on the gas that was thus used in 1925 gave from 3¢ to 25¢ per 1000 cu. ft., at the well. From the totals shown in the tabulation following herein, the average value for all fields in 1925 works out at approximately 8.2¢. Approximately 7000 cu. ft. of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4000 cu. ft. per 24 hr. are consumed by a 25-h.p. engine, and 63,700 cu. ft. per day for heating a 70-h.p. steam boiler, which figures have been utilized in compiling this report, in those cases where gas was not metered.

Natural Gas 'Consumed,' or Utilized for Fuel, 1925.

County.	*M cu. ft.*	*Value.*
Fresno	1,515,889	$116,711
Kern	45,649,845	2,290,608
Kings	740	440
Los Angeles	98,226,700	8,704,894
Orange	26,324,369	2,324,014
Santa Barbara	2,545,208	248,708
Tulare	280	175
Ventura	20,144,646	1,953,163
Butte, Humboldt, Lake, Mendocino, Sacramento, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Sutter, Yuba*	312,247	251,369
Totals	194,719,924	$15,890,082

* Combined to conceal output of a single operator in each.

The above totals for 1925 compare with 209,921,596 M cu. ft., valued at $15,153,140 in 1924. The only important increase in quantity in 1925 was made by Ventura County, which shows 20,144,646 M cu. ft., worth $1,953,163 as against 5,995,760 M cu. ft. and $633,352 in 1924. This was due to exploitation of deeper oil sands in the Ventura field. Fresno County showed a slight increase, Los Angeles, Orange, and Kern counties, in the order named, utilized somewhat smaller quantities of natural gas; but, with the exception of Los Angeles, there was a larger recovery of natural-gas gasoline from the gas treated.

Natural Gas Production in California, Since 1888.

The production of natural gas in California by years since 1888 is given in the following table. The first economic use of natural gas in California was from the famous Court House well at Stockton, bored in 1854–1858. Beginning about 1883 and for several succeeding years, a number of gas wells were brought in around Stockton. Natural gas was known in a number of other localities, and occasionally utilized in a small way, notably at Kelseyville in Lake County, and in Humboldt County near Petrolia and Eureka, but there are no available authentic

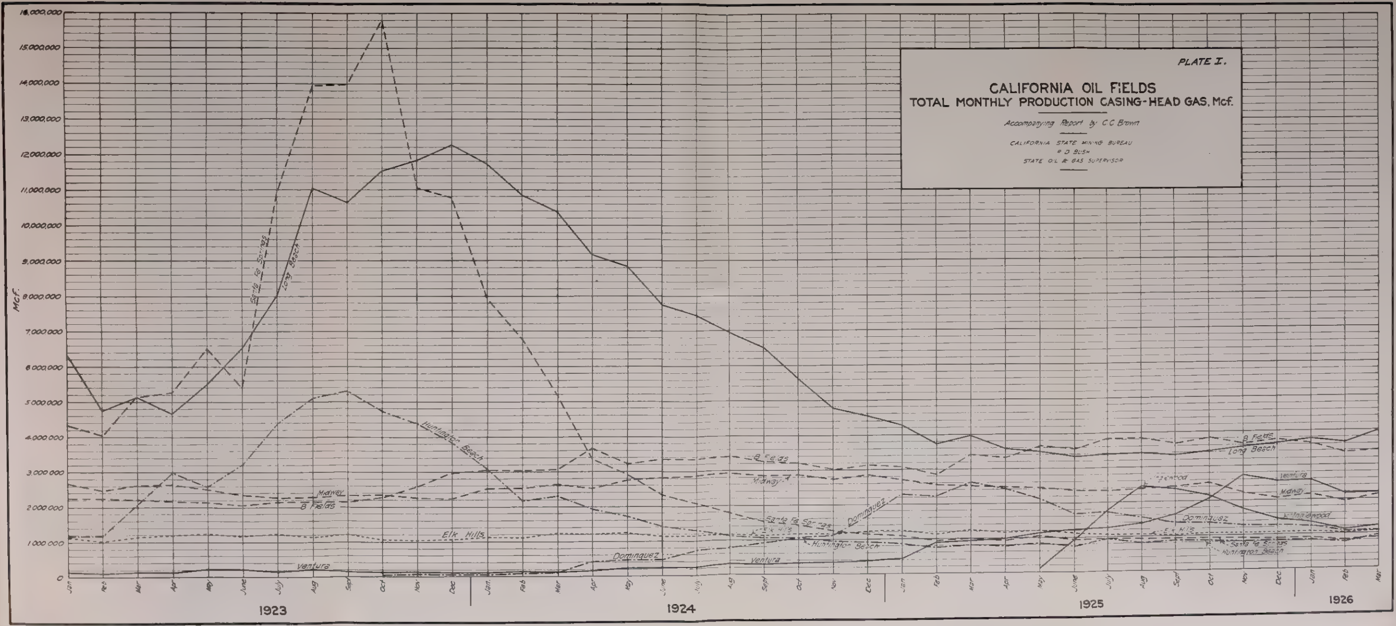


PLATE I.

CALIFORNIA OIL FIELDS
TOTAL MONTHLY PRODUCTION CASING-HEAD GAS, Mcf.

Accompanying Report by C C Brown

CALIFORNIA STATE MINING BUREAU
R D BUSH
STATE OIL & GAS SUPERVISOR

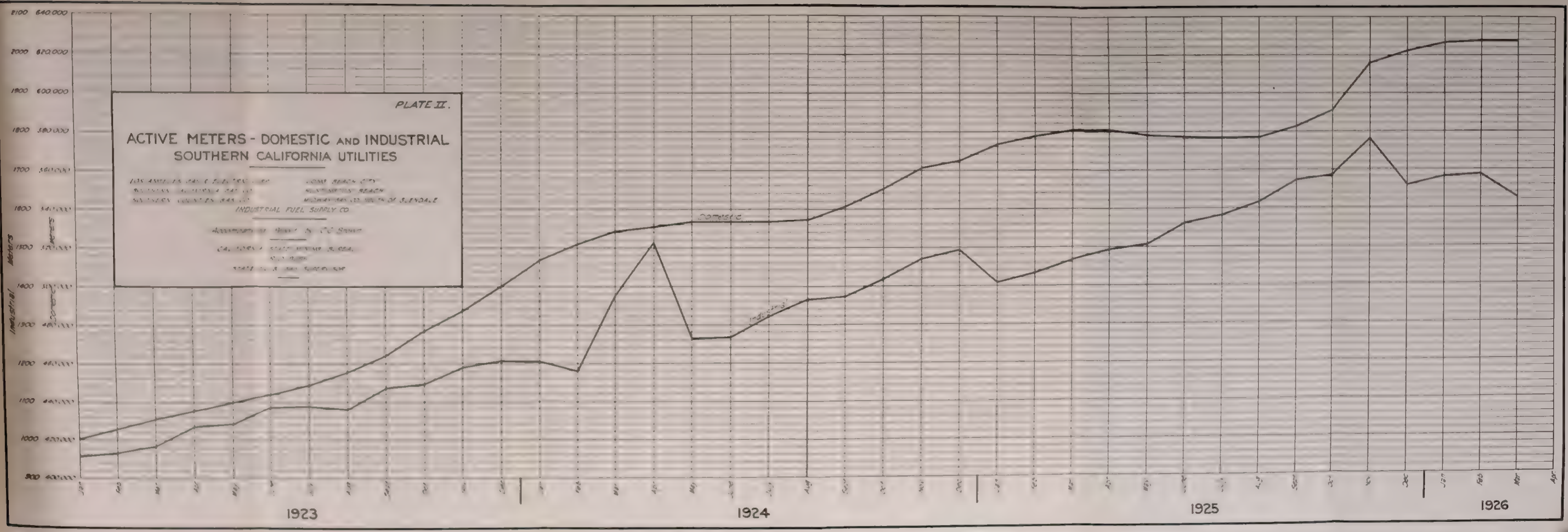


PLATE II.

ACTIVE METERS - DOMESTIC AND INDUSTRIAL
SOUTHERN CALIFORNIA UTILITIES

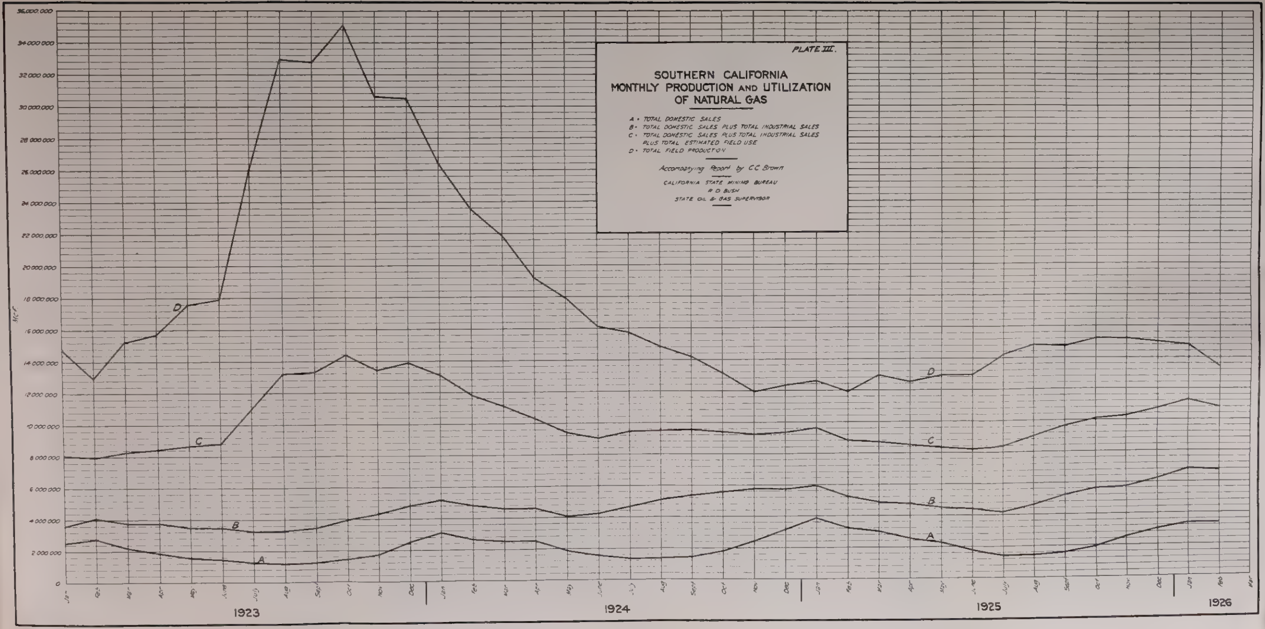


PLATE III.

SOUTHERN CALIFORNIA
MONTHLY PRODUCTION AND UTILIZATION
OF NATURAL GAS

A • TOTAL DOMESTIC SALES
B • TOTAL DOMESTIC SALES PLUS TOTAL INDUSTRIAL SALES
C • TOTAL DOMESTIC SALES PLUS TOTAL INDUSTRIAL SALES PLUS TOTAL ESTIMATED FIELD USE
D • TOTAL FIELD PRODUCTION

Accompanying Report by C C Brown

CALIFORNIA STATE MINING BUREAU
R D BUSH
STATE OIL & GAS SUPERVISOR

records of amounts or values previous to the year 1888. The most important developments in the commercial production of natural gas have been coincident with developments in the oil fields, by utilizing the casing-head gas as well as that from dry-gas wells.

Year	M cubic feet	Value
1888	[a]12,000	$10,000
1889	[a]14,500	12,680
1890	[a]41,250	33,000
1891	[a]39,000	30,000
1892	[a]75,000	55,000
1893	[a]84,000	68,500
1894	[a] [b]85,080	79,072
1895	[a] [b]110,800	112,000
1896	[a] [b]131,100	111,457
1897	[a]71,300	62,657
1898	[a]111,165	74,424
1899	115,110	95,000
1900	40,566	34,578
1901	120,800	92,034
1902	120,968	99,443
1903	120,134	75,237
1904	144,437	91,035
1905	148,345	102,479
1906	168,175	109.489
1907	169.991	114,759
1908	842,883	$474,584
1909	1,148,467	616,932
1910	10,579,933	1,676,367
1911	[a]5,000,000	491,859
1912	[a]12,600,000	940,076
1913	14,210,836	1,053,292
1914	16,529,963	1,049,470
1915	21,992,892	1,706,480
1916	28,134,365	2,871,751
1917	44,343,020	2,964,922
1918	46,373,052	3,289,524
1919	52,173,503	4,041,217
1920	58,567,772	3,898,286
1921	67,043,797	4,704,678
1922	103,628,027	6,990,030
1923	240,405,397	15,661,433
1924	209,021,596	15,890,082
1925	194,719,924	15,890,082
Totals	1,130,139,148	$84,936,967

[a] Quantity. in part, estimated, where values only were reported.
[b] Includes natural CO_2 from a mine in Santa Clara County.

Gasoline from Natural Gas.

More or less gas usually accompanies the petroleum in the oil fields, and such gas carries varying amounts of gasoline. A total of 163 plants by 83 operating companies or individuals were in operation in 1925 recovering gasoline by compression or absorption from this 'casing-head' gas. After the gasoline is extracted the remaining 'dry gas' so far as practicable is taken into pipe lines, by which it is distributed to consumers, both domestic and commercial.

In certain of the oil fields, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to its transmission to consuming centers through the gas pipe lines. Some concerns market the casing-head gasoline separately, others blend it with distillery gasoline, while others turn it into the oil pipe lines thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery where it is later regained. A total of 301,755,000 gallons of casing-head gasoline valued at $39,288,500 from all fields was reported as made during 1925, compared with 228,781,000 gallons valued at $22,269,955 by 82 operators and 137 plants in 1924. It was distributed by counties, as follows:

Natural-Gas Gasoline Recovered, 1925.

County	*No. plants*	*Gallons*	*Value*
Fresno	1	587,000	$76,427
Kern	44	59,030,000	7,685,706
Los Angeles	76	177,920,000	23,165,184
Orange	29	45,040,000	5,864,208
Santa Barbara	4	6,891,000	897,208
Ventura	9	12,287,000	1,599,767
Totals	163	301,755,000	$39,288,500

The usual recoveries of gasoline from natural gas vary from ⅕ gal. to 3 gal. per 1000 cu. ft. of gas handled, the average being about 1 gal. per 1000 cu. ft. A recent report by Mashaw & Swanson[1] gives the average recovery for 1925 as 1.281 gallons per 1000 cu. ft. of gas treated. Their figures show the following production, by methods:

Natural-Gas Gasoline Production, 1925, by Methods.

(Per U. S. Bureau of Mines)

Method.	*Gallons*	*Recovery (Gal. per M cu. ft.)*
Oil absorption	176,659,197	1.117
Compressor	6,718,091	1.369
Combination compressor and oil absorption	86,156,130	1.436
Combination oil and charcoal absorption	33,367,546	1.539
Drip	279,113	----
Totals	303,180,077	1.281

PETROLEUM.

Bibliography: State Mineralogist Reports IV, VII, X, XII, XIII. Bulletins 3, 11, 16, 19, 31, 32, 63, 69, 73, 82, 84, 89. Reports of Oil and Gas Supervisor 1915 to date (issued in monthly chapters since April, 1919). U. S. Geol. Surv., Bulletins 213, 285, 309, 317, 321, 322, 340, 357, 398, 406, 431, 471, 541, 581, 603, 621, 623, 653, 691; Prof. Papers, 116, 117. "American Petroleum; Supply and Demand": Amer. Petr. Inst., 1925.

The crude oil production of California for 1925 amounted to a total of 232,492,147 barrels of clean oil, valued at $330,609,829 at the well. This total of quantity is compiled from the monthly production reports filed by the operators with the State Oil and Gas Supervisor, to which have been added figures for the output of a number of small operators in the old Los Angeles City field not under the jurisdiction of the Supervisor, and a small production in San Mateo County which was also not reported to that office.

The question of the value of the crude oil yield at the well is a difficult one to settle with exactitude, principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil which they send direct from well to plant, hence much of the crude oil is not sold as such. The values used in the statistical reports of the State Mining Bureau since 1914 have been derived from averages of actual sales of crude oil of all grades in each field of the state, and these averages applied to the total yield of the respective fields. This we feel is a safer measure of commercial values than market quotations, because quotations do not always mean sales. This is particularly true on a rising or a falling market.

A comparison of the sales and quotations averages for the past ten years reveals a number of interesting developments, among which may be noted the following: On a rising market the average sales price for the year will be lower than the average of quotations; and on a falling market the average of sales will be higher than the quotation average. This is probably due, in part at least, to sales under time contracts.

---

[1] Mashaw, J. W., and Swanson, E. B., Statistical summary of the California petroleum industry, 1925: U. S. Bureau of Mines, 1926, p. 27.

Features of 1925.

The noteworthy features of the year 1925 in the oil industry of California were the higher prices prevailing and the increase in production due to the newer fields of Inglewood, Rosecrans, Dominguez, and Ventura, though this increase was partly offset by the increased amount of closed-in production and partly by decline in some of the older fields, particularly Long Beach.

Summarizing the data for the year, the State Oil and Gas Supervisor[1] presented the following figures:

"The total production of the state for the last six months of 1925 was 120,623,010 barrels of oil and 53,519,125 barrels of water. The production of oil for the year 1925 was, therefore, 232,334,238 barrels, an increase of 3,625,767 barrels over 1924. Production increased, notwithstanding that the amount of closed-in production in the state increased during the latter half of the year. The increased production was principally from four fields as follows:

Field.	*Increase of 1925 over 1924 production*
Inglewood	18,365,356 barrels
Rosecrans	7,191,880 barrels
Dominguez	6,767,640 barrels
Ventura	5,182,597 barrels
Total	37,507,473 barrels

This increase was partly offset by the increased amount of closed-in production, and partly by decline in some of the older fields, notably Long Beach, which produced 19,527,931 barrels less in 1925.

"The production of oil for the last half of 1925 was 8,911,782 barrels more than for the first half. Water production decreased 1,760,012 barrels during the same periods.

"The estimated closed-in production remained constant at about 25,000 barrels daily during the first five months of the year, but in June additional production from Elk Hills and Midway-Sunset was closed in, and the amount increased steadily in those and other fields to 60,454 barrels daily in December.

* * * * * * *

"Storage and Price Changes.

"The total crude and refined petroleum in storage in Pacific coast territory at the end of 1925 was 153,796,682 barrels, according to the American Petroleum Institute. The increase in storage during the year amounted to 28,774,718 barrels compared with an increase in 1924 of 8,294,522 barrels. The total amount of crude and refined oil shipped to eastern ports during 1925 was 27,937,000 barrels or 19,690,000 barrels less than the 1924 shipments.

"Prices of crude averaged higher in 1925 than in 1924. The prevailing price range of $1 to $1.82 per barrel in January was increased in February to a range of $1.25 to $2.40 per barrel and continued at that level until September 21, when it was reduced, ranging from $0.90 to $2.30 per barrel. A further reduction was made October 27 when the range in price was $0.75 to $2.30, affecting only the heavier grades. These prices continued for the remainder of the year.

"Drilling and Development.

"During 1925, 1359 wells were reported to the State Oil and Gas Supervisor as ready to drill, as compared with 1352 new wells in 1924. Of the total number 107, or 8 per cent, were wildcat wells. No new fields of importance were discovered, but considerable new producing area was added by extensions of the Long Beach and Midway fields. A small amount of oil was discovered at Seal Beach, Los Angeles County; in Sonoma County, near Petaluma; and in Monterey County, southwest of Salinas. New and deeper producing horizons were discovered in the Brea-Olinda, Sunset, and Cat Canyon fields."

Outlook for 1926.

Figures for the first six months of 1926 indicate a slight decline in yield for the current year compared with 1925. Production has dropped to around 610,000 barrels per day from the 1925 average of 634,000 barrels daily. Effective March 11th, prices were advanced for the lighter grades of crude oil.

---

[1] Bush, R. D., Résumé of oil field operations in California in 1925: Cal. State Min. Bur., 11th Ann. Rep. of State O. and G. Super. No. 8, Feb. 1926, pp. 5 and 6.

Production Figures.

The following table gives the production and value by counties for 1925, compared with the 1924 figures:

TABLE A.

Production and Value of Crude Oil, by Counties.

	1924		1925	
County.	*Barrels.*	*Value.*	*Barrels.*	*Value.*
Fresno	10,156,405	$11,801,743	7,773,665	$8,503,390
Kern	61,175,405	69,572,934	58,852,742	84,255,094
Los Angeles	119,027,428	147,474,953	121,214,551	173,215,593
Orange	31,661,283	37,455,298	32,734,420	46,384,673
San Luis Obispo	31,222	30,972	29,590	32,164
Santa Barbara	2,905,181	3,009,768	2,647,380	2,419,705
Santa Clara	14,417	20,481	13,828	22,594
Ventura	3,958,010	5,279,985	9,221,846	15,769,357
San Bernardino and San Mateo	[a]4,120	6,740	[b]4,125	7,259
Totals	228,933,471	$274,652,874	232,492,147	$330,609,829

[a] Combined to conceal output of a single operator in each.
[b] Combined to conceal output of a single operator in San Bernardino County.

The foregoing totals show a state average price of $1.422 per barrel for the year 1925, as compared to $1.200 in 1924 and $0.923 in 1923.

TABLE B.

Average Price of Oil per Barrel, by Counties, 1916-1925.

County	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Fresno	$0.545	$0.516	$0.825	$1.191	$1.293	$1.483	$1.068	$1.710	$1.162	$1.094
Kern	.423	.641	893	1.252	1.350	1.714	1.211	.819	1.137	1.432
Los Angeles	.629	.651	1.176	1.340	1.380	1.532	1.403	.971	1.239	1.429
Orange	.512	.663	1.003	1.412	1.860	2.138	1.175	.880	1.183	1.417
San Luis Obispo	--------	.450	.926	.905	1.040	1.400	.942	.600	.992	1.087
Santa Barbara	.611	.794	.808	1.235	1.125	1.575	1.011	.782	1.036	.914
Santa Clara	.666	.666	1.387	1.700	1.600	1.485	1.616	1.404	1.921	1.634
Ventura	.855	1.045	1.318	1.480	1.635	2.507	1.785	1.138	1.334	1.710
State average	$0.479	$0.636	$0.908	$1.278	$1.409	$1.726	$1.249	$0.923	$1.200	$1.422

For several years previous to 1919, the state average value per barrel at the well for crude oil as determined by the statistical returns was noted to practically coincide with the quotations during the same years for 23° gravity oil in the San Joaquin Valley fields. In 1919 and since, the average values have worked out at figures corresponding to quotations up to, in one year as high as 28° oil, due to the large yield of high-gravity oils from the new fields in the Los Angeles-Orange counties area.

TOTAL PETROLEUM PRODUCTION OF CALIFORNIA.

The presence of oil seepages and springs in Los Angeles and Ventura counties was known and utilized in a small way early in the history of California. Some also was shipped to refineries at San Francisco from Santa Barbara and Humboldt counties. In the light of present-day developments, the following reference to the previous year's production of oil and its future prospects as expressed by the San Francisco Bulletin of January 8, 1866, is strikingly prophetic even though skeptical:

> "It is possible that the small quantity received (40,000 or 50,000 gallons in 1865) may be the forerunner of many millions which will, at some future time, lubricate the wheels of commerce and set a trade at work excelling in variety any that has thus far been known on this coast. At present, however, we admit to being a little skeptical about the assumption of the astute Professor Silliman that California will be found to have more oil in its soil than all the whales in the Pacific Ocean."

According to Hanks,[1] in 1874 production amounted to 36 bbl. per day from natural flows in Pico Cañon (Newhall), and at Sulphur Mountain (Ventura County), the oil being of 32° gravity average.

> [2] "Work was commenced in Pico Cañon in 1875, by drilling three shallow wells with spring pole, all of which yielded oil at depths of from 90 to 250 feet. Actual work of development commenced with steam machinery in 1877."

In 1877 Pico averaged 40-50 bbl. daily, and Ventura 80 bbl. daily. In 1878, there was some production (@ 60 bbl. per day, for a time) from wells in Moody Gulch, near Los Gatos, Santa Clara County, the oil being of 46° Baumé.

The first wells in the Coalinga, Fresno County, and Summerland, Santa Barbara County, fields were drilled in 1890, but Coalinga did not make its influence felt conspicuously on the state's annual output until 1903. The Summerland yield never has been large. The Salt Lake field near Los Angeles began production in 1894 and in 1897 reached over a million barrels annually.

In the Kern County fields, the first well was drilled in Sunset in 1891, Midway in 1900, McKittrick in 1892, Kern River in 1899. The Sunset-Midway district attained a yield of over 4,000,000 bbl. in 1909, and over 20,000,000 bbl. in 1910. Kern River field produced over 3,000,000 bbl. in 1901.

The first well in the Santa Maria-Lompoc group, Santa Barbara County, was drilled in 1901, and the district advanced to a yield of over 3,000,000 bbl. annually in 1905.

The Whittier-Fullerton field in Los Angeles and Orange counties became an important factor in 1902. The Montebello field, Los Angeles County, was the conspicuous addition in 1918-1919; and Elk Hills, Kern County, with Huntington Beach and Richfield, Orange County, in 1920. In 1921, the new fields added were Long Beach and Santa Fe Springs, Los Angeles County; in 1922, Torrance field in Los Angeles County, and Wheeler Ridge field in Kern County; but the production from the large number of new wells started in these new Los Angeles County fields did not reach its peak until August and September, 1923. Dominguez (Compton) came in during 1923; followed by Rosecrans and Inglewood in 1924. Ventura recorded important additions to its producing area in 1925.

The effect of the advent of these various fields to the producing column will be noted in the tabulation herewith, by years:

---

[1] Hanks, Henry G., Report IV of State Mineralogist, p. 298, 1884.
[2] *Idem*, p. 301.

TABLE C.
Total Petroleum Production in California.

Year	Barrels	Value	Year	Barrels	Value
To and inc. 1875	(a) 175,000	(b) $472,500	1902	14,356,910	$4,692,189
1876	12,000	30,000	1903	24,340,839	7,313,271
1877	13,000	29,250	1904	29,736,003	8,317,809
1878	15,227	30,454	1905	34,275,701	9,007,820
1879	19,858	39,716	1906	32,624,000	9,238,020
1880	40,552	60,828	1907	40,311,171	16,783,943
1881	99,862	124,828	1908	48,306,910	26,566,181
1882	128,636	257,272	1909	58,191,723	32,398,187
1883	142,857	285,714	1910	77,697,568	37,689,542
1884	262,000	655,000	1911	84,648,157	40,552,088
1885	325,000	750,750	1912	89,689,250	41,868,344
1886	(a) 377,145	(b) 870,205	1913	98,494,532	48,578,014
1887	678,572	1,357,144	1914	102,881,907	47,487,109
1888	690,333	1,380,666	1915	91,146,620	43,503,837
1889	303,220	368,048	1916	90,262,557	57,421,334
1890	307,360	384,200	1917	95,396,309	86,976,209
1891	323,600	401,264	1918	99,731,177	127,459,221
1892	385,049	561,333	1919	101,182,962	142,610,563
1893	470,179	608,092	1920	103,377,361	178,394,937
1894	783,078	1,064,521	1921	112,599,860	203,138,225
1895	1,245,339	1,000,235	1922	138,468,222	173,381,265
1896	1,257,780	1,180,793	1923	262,875,690	242,731,309
1897	1,911,569	1,918,269	1924	228,933,471	274,652,874
1898	2,249,088	2,376,420	1925	232,492,147	330,609,829
1899	2,677,875	2,660,793			
1900	4,329,950	4,152,928	Totals	2,319,955,491	$2,217,354,451
1901	7,710,315	2,961,102			

[a] U. S. G. S., Min. Res. of U. S., 1886, p. 440, for quantities to and including 1886.
[b] Values have been estimated for the years to and including 1886, after consulting a number of contemporaneous publications, including the Mining & Scientific Press, Reports of the State Mineralogist, and U. S. Reports. The figures for 1887 to date are from records of the State Mining Bureau.

Well Data.

The following table is compiled from the monthly statements issued by the American Petroleum Institute:

TABLE D.
Well Operations by Fields, 1925.

Field	Wells producing Dec., 1924	Wells producing Dec., 1925	Wells completed during year	Total initial output	Wells abandoned during year	Barrels per well produced per day Dec., 1924	Barrels per well produced per day Dec., 1925
Kern River	2,158	[illegible]	19	936	3	8.3	11,836
McKittrick	[illegible]	302	4	266	6	19.5	5,577
Midway-Sunset	2,940	2,906	182	51,795	37	36.2	92,392
Elk Hills	251	240	23	9,307	4	144.5	29,182
Lost Hills-Belridge	316	291	3	95	1	15.6	4,204
[illegible]	1,053	922	20	374	6	23.7	15,646
Wheeler Ridge	[illegible]	[illegible]	10	788	5	68.0	1,065
Watsonville	5	6	......	......	......	9.5	57
Santa Maria-Lompoc	301	251	[illegible]	[illegible]	[illegible]	24.8	5,614
Summerland	135	135	......	......	......	1.1	128
Ventura-Newhall	566	591	45	[illegible]	22	20.6	35,743
Los Angeles-Salt Lake	396	387	1	890	35	5.4	1,914
Whittier	178	189	7	682	9	11.0	[illegible]
Fullerton	389	401	7	5,755	9	29.6	13,958
Coyote	231	309	3	725	[illegible]	88.0	17,093
Santa Fe Springs	354	350	4	1,114	[illegible]	143.1	49,960
Montebello	160	163	5	1,233	[illegible]	109.3	18,102
Richfield	177	155	9	3,610	4	65.0	13,357
Huntington Beach	238	335	42	9,186	18	140.8	46,342
Long Beach	[illegible]	620	105	35,160	63	[illegible]	108,986
[illegible]	510	603	111	14,241	57	88.1	31,515
[illegible]	38	62	32	29,680	8	1,398.1	24,951
[illegible]	17	113	113	76,658	12	449.3	24,582
Inglewood	–	171	178	202,458	11	59.5	62,904
*Newport	......	9	8	467	4	......	73
[illegible]	......	......	......	......	122	......	......
Totals	[illegible]	11,069	945	506,969	479	53.6	629,958

*Previous to April, 1925, Newport included in Huntington Beach.

Specific Gravity of Oils Produced.

The proportion of heavy and light oil produced in the various fields is shown in Table E, following, for which we are indebted to the Standard Oil Company. Under present practice, oil below 18° Baumé may be considered as largely refinable for fuel oil and lubricants, while the lighter oils yield varying amounts of the higher refined products with corresponding proportions of residuum and fuel oil. Specific gravities in California range from 8° Baumé in the Casmalia field, Santa Barbara County, to 56° Baumé in Ventura County.

California crude oils are all essentially of asphalt base, with a few notable exceptions. In the following localities are wells yielding crudes containing both asphalt and paraffine constituents: Oil City field, Coalinga; a few deep wells in East Side field, Coalinga; a considerable part of the Ventura County fields; Western Minerals area, south of Maricopa; Wheeler Ridge, Kern County.

TABLE E.

Production of Light and Heavy Oil, by Fields, 1925.

Field	Under 18° (barrels)	18° and over (barrels)	Total (barrels)
Kern River	5,964,465		5,964,465
Lost Hills-Belridge	428,420	1,325,811	1,754,231
McKittrick	2,122,123		2,122,123
Midway-Sunset	10,934,105	26,034,648	36,968,753
Elk Hills	1,197,638	10,819,361	12,016,999
Coalinga	3,877,777	3,915,981	7,793,758
Wheeler Ridge		344,646	344,646
Watsonville	23,725		23,725
Santa Maria	1,477,248	1,137,973	2,615,221
Summerland	41,790		41,790
Ventura-Newhall	66,892	9,211,247	9,278,139
Los Angeles-Salt Lake	723,035	2,113	725,148
Whittier-Fullerton	437,900	23,081,856	23,519,756
Santa Fe Springs		19,041,178	19,041,178
Huntington Beach	402,723	15,473,392	15,876,115
Long Beach	822,919	39,302,837	40,125,756
Torrance	3,028,123	10,248,055	13,276,178
Dominguez	30,762	13,317,517	13,348,279
Rosecrans		7,187,319	7,187,319
Inglewood	1,851,705	16,494,924	18,346,629
Miscellaneous	55,585	7,302	62,887
Totals	33,486,935	196,946,160	230,433,095

As previously noted by the writer,[1] a decided change has taken place in the relative proportions of light and heavy crudes produced in California since 1910, taking 18° Baumé as the dividing line. This subject has also been covered in detail and with charts, by Collom and Barnes.[2]

A marked drop took place in the low-gravity yield from 1910 to and including 1914. From 1914, it remained almost stationary, with a slight drop in 1921, while the high-gravity yield has increased at a rapid rate since 1915. The proportions have been reversed from approximately 75% low—25% high in 1914 to 25% low—75% high in 1921; 10% low—90% high in 1923; and 14% low—86% high in 1924–1925.

This has been an important factor in its effect upon the average price per barrel of the state's output in these years, as well as its effect upon the relative situation between production and consumption. It has been a fortunate development, in view of the increased demand for refinery products (gasoline in particular), and a lessened demand for fuel oil during 1919–1922 at least, owing in part to the shutting down of the western copper smelters which are large consumers of California fuel oil.

---

[1] Bradley, W. W., Mineral production of California in 1921: Cal. State Min. Bur., Report XVIII, p. 442, Sept. 1922.

[2] Collom, R. E., and Barnes, R. M., California oil production and reserves: Cal. State Min. Bur., Ninth Ann. Rep. of State Oil and Gas Supervisor, Aug., 1923, pp. 5-23.

Oil in 'Storage.'

Field, refinery, pipe-line, and tank-farm stocks of crude and refinery products in Pacific Coast territory totaled 153,795,682 barrels,[1] December 31, 1925, compared with 125,021,964 barrels on December 31, 1924, distributed as follows:

Stocks	*Dec. 31, 1925 (barrels)*	*Dec. 31, 1924 (barrels)*
Heavy Crude, heavier than 20° A.P.I., including all grades of fuel	82,849,057	57,254,796
Refinable Crude, 20° A.P.I., and lighter	44,345,837	40,574,578
Gasoline	10,172,562	10,957,487
Naphtha Distillates	6,548,483	9,396,613
All other stocks	9,879,743	6,838,490
Totals, all stocks	153,795,682	125,021,964

Operating Data.

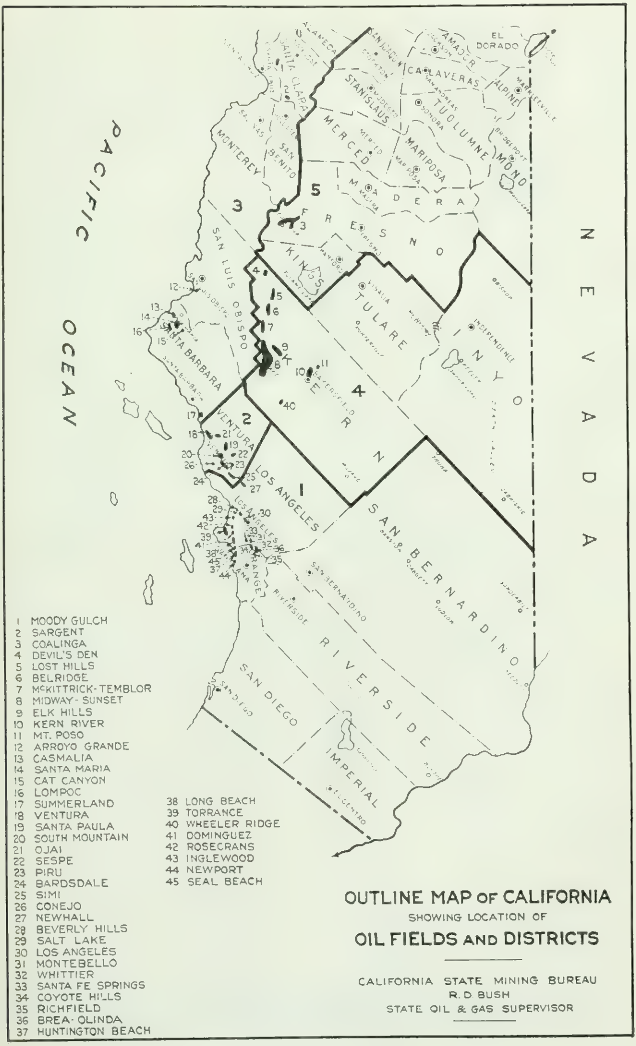
The following tabulation (Table F) is compiled from data published by the Department of Petroleum and Gas,[2] semiannually, and here combined to show the entire year's operations for all fields. The districts are the geographical subdivisions as administered by the Department, and which are outlined on the accompanying map.

It will be noted that the state average yield of oil per well per day was 58.9 barrels for the first six months of 1925 and 64.1 barrels for the second. This is somewhat higher than the figure of 56.1 barrels average for December derived from American Petroleum Institute data as shown in Table D, on a preceding page, due in part at least, to the fact that the latter is on a full-time basis, whereas the Bureau figures allow for shut-down time.

---

[1] Standard Oil Bulletin, February, 1926, p. 13.

[2] Summary of operations, California Oil Fields: Cal. State Min. Bur., Eleventh Ann. Rep. of State Oil and Gas Supervisor, Aug., 1925, pp. 6-7; Feb., 1926, pp. 8-9.



1	MOODY GULCH
2	SARGENT
3	COALINGA
4	DEVIL'S DEN
5	LOST HILLS
6	BELRIDGE
7	McKITTRICK-TEMBLOR
8	MIDWAY-SUNSET
9	ELK HILLS
10	KERN RIVER
11	MT. POSO
12	ARROYO GRANDE
13	CASMALIA
14	SANTA MARIA
15	CAT CANYON
16	LOMPOC
17	SUMMERLAND
18	VENTURA
19	SANTA PAULA
20	SOUTH MOUNTAIN
21	OJAI
22	SESPE
23	PIRU
24	BARDSDALE
25	SIMI
26	CONEJO
27	NEWHALL
28	BEVERLY HILLS
29	SALT LAKE
30	LOS ANGELES
31	MONTEBELLO
32	WHITTIER
33	SANTA FE SPRINGS
34	COYOTE HILLS
35	RICHFIELD
36	BREA-OLINDA
37	HUNTINGTON BEACH
38	LONG BEACH
39	TORRANCE
40	WHEELER RIDGE
41	DOMINGUEZ
42	ROSECRANS
43	INGLEWOOD
44	NEWPORT
45	SEAL BEACH

OUTLINE MAP OF CALIFORNIA
SHOWING LOCATION OF
OIL FIELDS AND DISTRICTS

CALIFORNIA STATE MINING BUREAU
R. D. BUSH
STATE OIL & GAS SUPERVISOR

TABLE F. Production Statistics and Operating Data of California Oil Fields 1925.

Field	January 1 to June 30						July 1 to December 31					
	Average number of producing wells—actual	Oil (bbl.)	Number of days producing	Production per well per day (bbl.)		Percentage of time wells produced	Average number of producing wells—actual	Oil (bbl.)	Number of days producing	Production per well per day (bbl.)		Percentage of time wells produced
				Oil	Water					Oil	Water	
District No. 1:												
Beverly Hills	14	77,551	2,474	31.3	51.4	97.6	15	77,805	2,401	32.4	49.5	87.0
Brea Olinda	395	2,222,172	64,014	34.7	13.0	89.6	393	2,398,051	65,220	36.8	14.4	90.2
Coyote Hills	224	a3,778,599	39,029	96.8	33.6	96.3	218	3,511,808	38,257	91.8	34.1	95.4
Dominguez	57	8,301,626	9,331	890.0	25.1	90.4	66	5,213,775	11,022	473.0	27.0	90.8
Huntington Beach	330	a7,781,437	53,349	145.9	20.9	89.3	346	b8,522,295	57,851	147.3	27.4	90.9
Inglewood	31	2,620,186	3,749	698.9	6.3	66.8	156	15,751,350	25,748	611.8	22.5	89.7
Long Beach	539	a21,168,239	91,291	231.9	38.8	93.6	569	b19,395,621	97,355	199.2	52.2	93.0
Montebello	162	3,445,126	27,889	123.5	65.8	95.1	166	3,456,759	29,088	118.8	67.8	95.2
Newhall	76	40,998	12,863	3.2	6.0	93.5	78	b44,931	13,923	3.2	4.3	97.0
Newport	7	19,796	571	34.7	7.5	45.1	8	b17,523	935	18.7	13.8	63.5
Richfield	180	a2,072,658	30,151	68.7	10.0	92.5	182	2,413,321	31,496	76.6	6.8	94.1
Rosecrans	52	a3,337,838	7,780	429.0	20.9	82.7	102	b1,388,545	15,343	286.0	42.8	81.8
Salt Lake	85	197,364	14,826	13.3	24.7	96.4	82	191,253	14,156	13.5	24.2	93.8
Santa Fe Springs	379	a9,465,787	61,683	153.5	38.4	89.9	365	9,879,075	61,609	160.4	48.0	91.7
Torrance	582	a7,123,179	92,539	77.0	1.9	87.8	618	b6,112,088	101,500	60.2	2.4	89.3
Whittier	169	382,812	26,625	14.4	24.1	87.0	172	381,843	27,136	14.1	24.1	85.7
Totals	3,282	72,038,368	538,194	133.9	24.4	90.6	3,536	81,756,043	593,040	137.9	28.7	91.1
District No. 2:												
Bardsdale	144	177,466	25,532	7.0	1.4	97.9	117	186,769	26,455	7.1	1.0	97.8
Conejo	22	106	572	4.1	1.1	14.3	52	7,476	6,645	1.1	5.8	69.5
Ojai	69	37,149	11,910	3.1	1.9	95.4	70	36,305	12,146	3.0	2.1	94.3
Piru	80	61,546	13,319	4.6	12.0	92.0	93	64,611	14,219	4.5	15.4	83.1
Santa Paula	39	13,351	5,547	2.4	0.3	78.5	31	11,223	5,084	2.2	2.0	89.1
Sespe	22	25,802	3,82[illegible]	6.7	0.9	96.7	24	22,875	4,295	5.3	0.7	97.3
Simi	51	29,796	8,053	3.7	1.5	87.2	51	28,375	8,224	3.5	1.3	87.6
South Mountain	57	760,556	9,662	78.7	0.1	93.7	59	729,695	10,512	69.4	0.1	96.8
Ventura	40	2,590,585	6,365	407.0	56.8	87.9	56	4,438,160	8,291	535.3	38.9	80.5
Totals	524	3,696,357	84,778	43.6	6.9	89.4	583	5,525,489	95,871	57.6	6.9	89.4

District No. 3:												
Arroyo Grande	19	15,756	3,165	5.0	4.6	92.0	19	13,834	3,063	4.5	4.5	87.6
Casmalia	94	471,056	15,370	30.6	216.4	90.3	72	286,143	11,288	25.3	222.5	85.2
Cat Canyon	37	301,965	5,970	50.6	11.7	89.1	38	362,446ᵃ	6,026	60.1	10.3	86.2
*Half Moon Bay	4	*388	362	1.1	0.3	50.0	4	*388	368	1.1	0.3	50.0
Lompoc	1	18,995	181	104.9	1.2	100.0	1	18,460	184	100.3	0.9	100.0
Moody Gulch	3	330	513	0.6	0.3	94.5	3	*338	552	0.6	0.3	100.0
Santa Maria	155	562,750	22,007	25.6	37.1	78.7	157	573,365	22,576	25.4	39.3	78.2
Sargent	9	6,660	1,629	4.1	0.0	100.0	9	6,500	1,656	3.9	0.0	100.0
*Summerland	134	*26,100	22,305	1.2	12.9	92.0	134	*26,100	22,305	1.2	12.9	90.6
Totals	456	1,404,000	71,502	19.6	63.2	86.6	437	1,287,574	68,018	18.9	55.3	84.6
District No. 4:												
Belridge-Lost Hills-Devils Den	291	887,262	48,978	18.1	48.5	93.0	290	827,733	47,880	17.3	47.6	89.7
Elk Hills	278	6,782,071	46,546	145.7	8.9	92.5	241	5,229,126	39,696	131.7	8.1	89.5
Kern River	2,193	3,100,983	376,408	8.2	50.1	94.8	1,919	2,627,218	330,040	8.0	43.8	93.5
McKittrick-Temblor	303	1,066,365	52,440	20.3	67.7	95.6	304	1,078,301	53,209	20.3	77.0	95.1
Midway-Sunset	2,944	18,633,659	496,478	37.5	20.1	93.2	2,809	18,269,215	485,218	37.7	18.8	93.9
Wheeler Ridge	16	174,740	2,697	64.8	8.2	93.1	20	176,069	3,447	51.1	7.2	93.7
Totals	6,025	30,645,080	1,023,547	29.9	34.4	93.9	5,583	28,207,662	959,490	29.4	31.6	93.4
District No. 5:												
Coalinga	1,061	3,927,423	177,463	22.1	10.7	92.4	955	3,846,242	164,610	23.4	10.8	93.7
Grand totals	11,348	111,711,228	1,895,484	58.9	29.2	92.3	11,094	120,623,010	1,881,029	64.1	28.5	92.1

ᵃ The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures:

Coyote Hills	2	500	60
Huntington Beach	5	10,332	79
Long Beach	47	228,114	1,257
Richfield	6	3,500	175
Rosecrans	5	57,088	80
Santa Fe Springs	6	9,930	112
Torrance	4	3,176	70

ᵇ The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures:

Huntington Beach	2	8,935	199
Long Beach	10	254,140	1,323
Newhall	4	4,910	480
Newport	1	475	15
Rosecrans	2	18,860	224
Torrance	4	25,145	666

* Estimated.

Financial and Operating Conditions of California Oil Fields, 1925.

Financial results of the oil business during 1925 are shown by the following tables. The features worthy of mention are: (1) The higher price received for the year as shown by the state average of all grades, but especially the lighter gravities. (2) Increases in the dividends paid by companies operating in Los Angeles County, and in the Kern River and Midway fields, and an increase in the state total of dividends for the year. (3) Decreases in the number of barrels per well per day yield (see Table I) in most of the older fields. (4) Somewhat higher operating costs per barrel in most of the fields.

With reference to Table I, it should be noted that although it lacks data from the larger operators who have refineries and with interests in more than one field, yet the data given are of economic value and interest in that they indicate the conditions prevailing among the smaller companies and operators.

Operating cost per well is not always lower for the dividend companies than others. Profitable operations seem to depend generally upon large wells, high-grade oil, and proximity to market. Price and profits have usually been greater in the Los Angeles-Orange-Ventura fields than in others, doubtless largely due to the proximity to market and higher grades of oil. Crude oil testing as high as 56° Baumé is obtained from some of the Ventura wells.

TABLE G. CAPITALIZATION.

Field	Number of companies considered[*]	Per cent of total product of field	Capital	
			Cash	Property
Fresno County—Coalinga	51	30	$2,329,181	$20,704,399
Kern County:				
Kern River	49	35	8,069,225	5,320,188
Midway	58	37	4,852,681	40,003,673
Sunset and Maricopa	27		1,703,155	4,010,165
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	38	12	3,025,038	3,232,748
Los Angeles County	98	24	48,085,433	29,136,859
Orange County	44	43	5,042,395	11,204,504
Santa Barbara County	24	30	2,865,348	14,098,562
Ventura County	34	24	2,100,167	14,958,883
Subtotals	423	..	$78,072,623	$142,669,981
Miscellaneous and marketing companies[a]	92	56	378,471,264	155,819,413
Totals	515	....	$456,543,887	$298,489,394

[*] See Table I, following.

[a] Includes companies having refineries, and those operating in several fields whose data could not be segregated as to counties or fields.

TABLE H. Dividends Paid by Oil Companies. 1920-1925.

Field	1920		1921		1922		1923		1924		1925	
	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value
Coalinga	29	$1,297,694	24	$1,142,767	20	$893,210	17	$383,675	13	$239,985	20	$815,625
Kern River	26	783,625	28	390,794	20	594,306	13	187,170	20	67,468	20	1,083,147
Midway	39	7,096,819	34	4,311,539	30	2,706,985	19	2,438,695	31	3,528,930	27	5,078,020
Sunset, Maricopa and Wheeler Ridge	14	691,611	18	960,459	19	936,174	11	259,569	13	739,494	13	306,089
McKittrick, Belridge, Lost Hills, Devils Den, Elk Hills	12	1,231,045	13	2,603,490	10	733,460	11	1,021,602	5	1,594,497	6	762,526
Santa Barbara County	7	312,332	5	400,535	5	317,014	3	163,600	3	221,916	2	124,267
Ventura County	5	559,942	6	1,362,210	7	1,204,631	4	126,784	4	303,000	5	438,407
Los Angeles County	20	3,282,497	11	562,224	16	1,442,470	32	5,627,346	34	3,458,221	36	9,172,047
Orange County			11	1,395,158	8	331,345	12	897,119	11	2,717,050	15	1,194,391
Subtotals	152	$15,255,565	150	$13,129,176	135	$9,159,595	122	$11,105,560	134	$12,870,561	144	$18,974,519
Miscellaneous and marketing companies [a]	9	31,072,321	11	35,886,119	10	41,030,594	10	44,398,555	36	52,150,372	27	53,459,294
Totals	161	$46,327,886	161	$49,015,295	145	$50,190,189	132	$55,504,115	170	$65,020,933	171	$72,433,813

[a] See Table G, preceding.

TABLE I. Average Prices of Light and Heavy Oils, and Operating Data, 1925.

Field	Price				Operating data					
					All companies considered *			Dividend companies [a]		
	Under 18° Baume	18° and over	Average price	Price to dividend companies	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel
Fresno County—										
Coalinga	$1.080	$1.181	$1.094	$1.101	15.9	$6.58	$0.414	18.0	$6.98	$0.388
Kern County—										
Kern River	1.087		1.087	1.075	8.3	3.32	0.400	6.9	2.13	0.308
Midway	1.070	1.660	1.590	1.668	44.3	18.25	0.412	45.0	16.92	0.376
Sunset and Maricopa	1.129	1.372	1.205	1.240	20.35	7.98	0.392	18.72	7.41	0.396
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	1.100	1.428	1.283	1.108	20.3	7.31	0.360	21.1	5.84	0.277
Los Angeles County	1.057	1.434	1.429	1.422	110.2	52.41	0.476	118.8	51.44	0.433
Orange County	1.190	1.421	1.417	1.414	92.6	56.83	0.614	90.9	54.46	0.599
Santa Barbara County	0.766	1.190	0.914	1.005	32.3	18.48	0.572	43.4	6.47	0.149
Ventura County	1.135	1.715	1.710	1.717	45.4	24.45	0.539	57.46	38.44	0.669

*See Table G, preceding. Does not include companies with refineries, nor those operating in several fields whose data could not be segregated as to counties or fields. The data given are of value, however, as showing the conditions obtaining among the smaller operators.

[a] See Table H, preceding.

It should be noted that in the case of a county like Ventura, with only a few producers, the averages are not so significant as in other fields with a large number of operators. The figures of a single large operator in such a case can materially affect the general average if they should be much above or below the average of the others.

Proved Oil Land.

The total proved oil land of the state increased to 121,436 acres, as against 118,979 acres in 1924. Of this 1925 total, 22,673 acres being owned by federal, state and city governments, or for other reasons, is not assessable for the support of the Department of Petroleum and Gas of the State Mining Bureau. The acreage in 1925 was distributed by counties as follows:

TABLE J.

Proved Oil Lands and Number of Wells, 1925.

County	*Land (acres)*	*Number wells*
Fresno	14,636	969
Kern	76,398	5,931
*Los Angeles	11,239	2,807
Orange	6,630	979
San Bernardino	------	1
San Luis Obispo	402	11
San Mateo	------	3
Santa Barbara	7,823	354
Santa Clara	80	9
Ventura	4,228	571
Totals	121,436	11,635

*Not including the old Los Angeles City field.

CHAPTER THREE.

METALS.

Bibliography: Reports of State Mineralogist I–XXI (inc.). Bulletins 5, 6, 18, 23, 27, 36, 50, 57, 76, 78, 85, 92, 95. Spurr and Wormser, "Marketing of Metals and Minerals." See also under each metal.

The total value of metals produced in California during 1925 was $24,403,794. The chief of these is, and always has been, gold, followed in 1925 by copper, silver, zinc, lead, quicksilver, tungsten, platinum and manganese ore. There was a small output of iron ore and antimony. There was no production of arsenic, cadmium, molybdenum, nor tin which have in the past been on the active list. Deposits of ores of nickel and vanadium have also been found in the state; although there has yet been no commercial output of them. The above-noted total for this group is a net increase of $4,395,020 over the 1924 total of $24,008,774, due mainly to increases registered by lead and zinc, in spite of decreases by copper, gold and silver.

California leads all states in the Union in her gold production and is credited with approximately 30% of the nation's yield in 1925. The precious metal is widely distributed through the state. Thirty-four of the fifty-eight counties reported an output in 1925 from either mines or dredges.

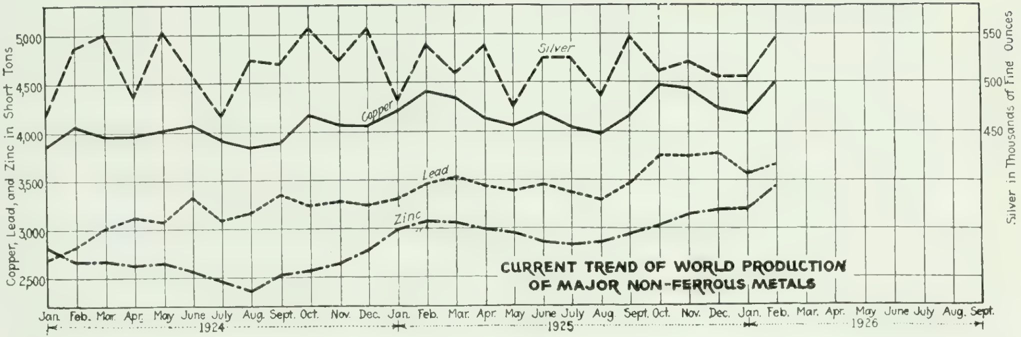
Copper, which is second in importance among the metals of the state, occurs in the following general districts: the Shasta County belt, which has been by far the most important; the Coast Range deposits, extending more or less continuously from Del Norte in the north to San Luis Obispo County in the south; the Sierra Nevada belt, starting in Plumas and running in a general southerly and southeasterly direction through the Mother Lode counties and ending in Kern; the eastern belt in Mono and Inyo counties; and the southern belt, in San Bernardino, Riverside and San Diego counties.

Silver is not generally found alone in the state, except notably in the Rand district, San Bernardino County; but is associated to a greater or less extent with gold, copper, lead, and zinc.

Quicksilver has for many years been one of the state's staple products and California has supplied approximately 75% of the nation's output of this metal.

Tungsten is found in but few other localities of importance in the United States.

Large deposits of iron ore have long been known in several sections of the state, but for various economic reasons this branch of the mineral industry thus far has made only slight progress on the Pacific Coast.



These curves are not to be considered as permanent records of production. They show merely the current trend in terms of daily output, according to latest estimates of the American Bureau of Metal Statistics. The figures represent countries that produced in 1923 and 1924 about 97 per cent of the world's output of copper; 78.5 per cent of the lead; 87.5 per cent of the zinc and 81 per cent of the silver.—Eng. Min. Jour.-Press, April 3, 1926.

A comparison of the 1925 metal output with that of the 1924 is afforded by the following table:

Substance	1924		1925		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Copper	52,089,349 lbs.	$6,823,704	46,968,499 lbs.	$6,669,527	$154,177—
Gold		13,150,175		13,065,330	$4,845—
Lead	4,984,387 lbs.	398,751	7,352,722 lbs.	639,661	240,910+
Manganese ore	1,115 tons	25,785	832 tons	19,450	6,335—
Platinum	273 fine oz.	36,452	292 fine oz.	39,937	3,485+
Quicksilver	7,948 flasks	543,080	7,683 flasks	621,831	78,751+
Silver	3,555,153 fine oz.	2,381,952	3,054,416 fine oz.	2,119,765	262,187—
Tungsten concentrates	781 tons	446,009	573 tons	348,471	97,538—
Zinc	3,060,000 lbs.	198,900	11,546,602 lbs.	877,542	678,642+
Unapportioned*		3,966		2,280	1,686—
Total value		$24,008,774		$24,403,794	
Net increase					$395,020+

*Includes iron ore and arsenic in 1924; iron ore and antimony in 1925.

ALUMINUM.

Bibliography: Report XVIII, p. 198. Bulletins 38, 67. U. S. Geol. Surv., Min. Res. of U. S.

To date there has been no commercial production of aluminum ore in California. Only a single authenticated occurrence of bauxite has thus far been noted in this state, being in Riverside County, southeast of Corona, but as yet undeveloped.

Minerals containing aluminum are abundant, the most widely distributed being the clays. There are only two, however, thus far of consequence, commercially, in the production of the metal: bauxite (to which may be added the related hydrated oxides, hydrargillite and diaspore) and cryolite. Cryolite is found in commercial quantities only in South Greenland, and was formerly the only ore of aluminum used, being still employed as a flux in the extraction of the metal. Bauxite has been, for some years, the most important source of aluminum and its salts. Its color varies from gray to red, according to the amount of iron present, the composition ranging usually between the following limits: Al_2O_3, 30%–60%; Fe_2O_3, 3%–25%; SiO_2, 0.5%–20%; TiO_2, 0.0%–10%. Besides its reduction to the metal, bauxite is also utilized in the manufacture of aluminum salts, refractory bricks, alundum (fused alumina) for use as an abrasive; and in the refining of oil (stated to be of great importance). The most important producing countries, both of bauxite and the metal, are the United States and France, the former yielding more than 60 per cent of the world's output. In 1913 France led.

ANTIMONY.

Bibliography: State Mineralogist Reports VIII, X, XII, XIII, XIV, XV, XVII. Bulletin 38.

Production of antimony in California has been irregular, and small in amount except during 1915–17 when the high war-time prices permitted American producers, for a short period, to compete with Chinese antimony. The principal commercial production of antimony in California has come from Kern, Inyo and San Benito counties, and other occurrences have been noted in Nevada, Riverside and Santa Clara counties. The commonest occurrence is in the form of the sulphide, stibnite; but in the Kernville and Havilah districts in Kern County there were notable deposits of the native metal, being among the few localities of the world where native antimony has been found.

Californian producers claim that they can not operate profitably unless the price of antimony be above 12 cents per pound. Present New York quotations are around 17 cents per pound, owing to a shortage of the metal as a result of the rioting and revolutionary fighting that has been going on in China for the past two years. China is the principal world source of antimony. As a consequence, there is again some revival of antimony mining in California.

Pure antimony metal and manufactured antimony compounds are of considerable importance as pigments in the ceramic industry. The most important use of the metal, commercially, is in various alloys, particularly type-metal (with tin and lead), babbitt (with tin and copper), and britannia metal (with tin and copper).

Antimony Production of California, by Years.

The production of antimony in California by years since 1887 has been as follows:

Year	Tons	Value	Year	Tons	Value
1887	75	$15,500	1900	70	$5,700
1888	100	20,000	1901	50	8,350
1889			1902		
1893	50	2,250	1915	510	35,666
1894	150	6,000	1916	1,015	64,793
1895	33	1,485	1917	158	18,786
1896	17	2,320	1918		
1897	20	3,500	1925	*	*
1898	40	1,200			
1899	75	13,500	Totals	2,363	$199,050

*Under 'Unapportioned.'

ARSENIC.

Bibliography: Report XVIII. Bulletin 67. U. S. G. S., Min. Res. of U. S.

Arsenic is found in a number of localities in California in the mineral arsenopyrite ($FeAsS$), which is frequently gold bearing; and in scorodite ($FeAsO_4+2H_2O$), an oxidation product of arsenopyrite. The occurrence of realgar (AsS) has also been noted. The principal source of the arsenic of commerce in the United States has been as a by-product from the metallurgical treatment of copper, gold, and lead ores. It is usually recovered in the form of the tri-oxide, or 'white arsenic,' for which there is a demand for the preparation of insecticides, for use in agriculture and horticulture, and especially against the cotton-boll weevil in the southern states.

Up to the beginning of 1924, there had been no commercial recovery of arsenic from Californian ores. In that year the plant of the Chipman Chemical Company at Bay Point began the preparation of arsenic compounds from Californian and Nevadan ores, by a chemical process, but the plant burned late in the year and has not since been rebuilt.

BERYLLIUM.

Bibliography: Eng. & Min. Jour.-Press, Vol. 118, No. 8, p. 285, Aug. 23, 1924.

Beryllium is a metal resembling aluminum closely in its chemical character, and has a specific gravity of 2.7. Several alloys have been prepared experimentally, of which copper-beryllium has received the most attention. The addition of 5% beryllium produces a golden-yellow alloy.

The compounds of beryllium at present used commercially are the nitrate and oxide. The nitrate is used by incandescent mantle manufacturers to harden the thorium oxide skeleton, the amount varying from 2 gm. to 5 gm. per kilogram of thorium nitrate. The oxide has been added to materials being used for the manufacture of abrasive compounds and in dental cements, and has also been recommended as a condensing agent in the preparation of certain esters. It is stated that this latter property may prove of value to manufacturers of synthetic perfumes and essences. Beryllium sulphate has been used to some extent in medical research.

There are a number of beryllium minerals, but none have been found in commercial quantities, except beryl, which is a beryllium-aluminum silicate carrying, when pure, 57% silica, 19% alumina, and 14% beryllium oxide. Beryl suitable for commercial purposes should carry from 10% to 12% beryllium oxide. The ore before use is ground to pass 90%–95% through a 200-mesh screen. It should be white in color, free from iron-bearing minerals and metallic iron. The price varies from 4¢ to 5¢ per pound in carload lots, according to demand and percentage of beryllium oxide. The chief use at present for ground beryl is as an addition to porcelain products, where it reduces the coefficient of expansion. Beryllium metal is difficult to separate from aluminum. For this reason, the mineral phenacite (Be_2SiO_4) would be a more desirable source for the metal, and it carries aproximately 45% beryllium oxide.

Beryl occurs in California in the pegmatite dikes of the tourmaline gem district in northern San Diego and southwestern Riverside counties. Thus far there have been no commercial shipments of beryl except for gem purposes (the pink and aquamarine varieties.)

BISMUTH.

Bibliography: Bulletins 38, 67. Am. Jour. Sci. 1903, Vol. 16.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside counties near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne and Mono counties, but only in small quantities. The only commercial production recorded was 20 tons valued at $2,400, in 1904, and credited to Riverside County.

In 1917, a few pounds of bismuthinite (Bi_2S_3) with associated bismutite ($Bi_2CO_5H_2O$), was taken out at the United Tungsten Copper Mine, in the Morongo district, San Bernardino County. It is associated with scheelite in a contact deposit between limestone and granite.

Recovery of bismuth from blister copper in the electrolytic refinery has been noted,[1] ranging as high as 27.3 pounds of metallic bismuth per 100 tons of blister copper from the Iron Mountain, Shasta County, ores. In the United States, the principal recovery of bismuth is obtained as a by-product from the refining ot lead bullion.

The uses of bismuth are somewhat restricted, being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems, in electrical fuses, and in solders.

Present quotations for bismuth are around $2.70 per pound for the refined metal.

CADMIUM.

Bibliography: U. S. Geol. Surv., Min. Res. of U. S., 1908, 1918.

During 1917 and 1918, cadmium metal was recovered by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County. It was shipped in the form of 'sticks' and amounted to a total of several thousand pounds for the two years, the exact figures being concealed under 'Unapportioned.' That was the first, and thus far the only, commercial production of cadmium recorded from Californian ore. Cadmium there occurs associated with zinc sulphide, sphalerite, probably as the sulphide, greenockite. Cadmium also occurs in the Cerro Gordo Mine, Inyo County, associated with smithsonite (zinc carbonate).

There are several cadmium minerals, but none of them occur in sufficient quantities individually to be profitable as distinct ores. The cadmium of commerce is derived as a by-product in the reduction of zinc minerals and ores, in nearly all of which it occurs in at least minute proportions, the average ratio being about 1 of cadmium to 200 of zinc. As cadmium behaves metallurgically much the same as zinc, it constitutes a fraction of 1 per cent of nearly all metallic zinc.

Cadmium is produced in the United States in two forms—metallic cadmium and the pigment, cadmium sulphide. The principal use of the metal is in low-melting point, or cliché alloys, and its salts are utilized in the arts, medicine, and in electroplating. The sulphide is employed as a paint pigment, being a strong yellow, which is unaffected by hydrogen sulphide gas from coal smoke. It is also employed in coloring glass and porcelain. Cadmium cliché metal is stated to be superior to the corresponding bismuth alloy, for making stereotype plates. Cadmium is also used in bronze telegraph and telephone wires, and gives some promise of being utilized in electroplating.

Present quotations for cadmium are 60¢ per pound for the refined metal.

COBALT.

Bibliography: Report XIV. Bulletin 67. U. S. G. S., Min. Res. of U. S., 1912, 1918.

Occurrences of some of the cobalt minerals have been noted in several localities in California, but to date no commercial production has resulted. Some of the copper ores of the foothill copper belt in Mariposa and Madera counties have been found to contain cobalt up to 3%. The most recent and notable occurrence thus far found in this state is in the Mar-John Mine near Sheep Ranch, Calaveras County. Lenses of smaltite ($CoAs_2$) have been uncovered in the vein, there, and several tons taken out in the course of development work; but as yet there have been no commercial shipments.

---

[1] Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217-218.

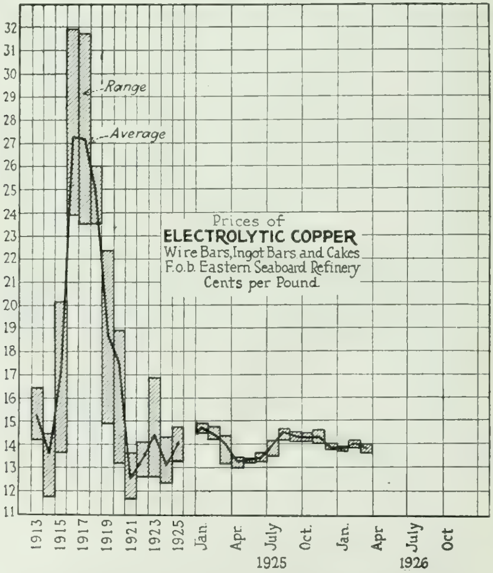
The most important use of cobalt is in the manufacture of the alloy, stellite, in which it is combined with chromium, for making high-speed lathe tools, and non-tarnishing cutlery and surgeons' appliances. The metal is also used in electroplating, similarly to nickel; and the oxide, carbonate, chloride, sulphate and other salts are used in ceramics for coloring. Some of the organic salts of cobalt (acetate, resinate, oleate) are employed as 'driers' in paint and varnish.

Present quotations for cobalt are $2.50 per pound for the refined metal.

COPPER.

Bibliography: State Mineralogist Reports VIII–XXII (inc.). Bulletins 23, 50, 91.

Copper is second only to gold among the metals produced in California. The output for 1925 amounted to a total of 46,968,499 pounds of recoverable metal valued at $6,669,527, a slight decrease from the 1924 figures of 52,089,349 pounds and $6,823,704. The average price for 1925 being higher (14.2¢ against 13.1¢ per pound) than in 1924,



From Engineering and Mining Journal-Press, April 3, 1926.

the drop in total value was not as great in proportion as the decrease in quantity. The average price in 1923 was 14.7¢ per pound.

As for several years past, Plumas County ranked first for 1925 with an output of 26,950,029 pounds; Shasta second, with 14,565,967 pounds; and Calaveras third, with 4,906,650 pounds.

Distribution of the 1925 copper output, by counties, was as follows:

Copper Production, by Counties, 1925.

County	*Pounds*	*Value*
Calaveras	4,906,650	$696,744
Inyo	73,003	10,367
Mono	1,020	145
Plumas	26,950,029	3,826,904
Riverside	23,134	3,285
San Bernardino	6,249	888
Shasta	14,565,967	2,068,367
Trinity	439,766	62,447
Amador, Butte, Kern, Lake, Los Angeles, Nevada, Orange, Placer*	2,681	380
Totals	46,968,499	$6,669,527

*Combined to conceal output of a single operator in each.

Copper Production of the United States.

According to preliminary data issued by the U. S. Bureau of Mines,[1] the smelter production of primary copper from domestic sources during 1925 amounted to 1,674,869,886 pounds, an increase of approximately 2%. The value of smelter production increased approximately 11% in 1925. The average price of 2,634,000,000 pounds of copper delivered during the year, as reported to the Bureau by selling agencies, was 14.2¢ per pound.

"REFINED COPPER.

"The total production of new refined copper in 1925 was 2,205,000,000 pounds, a decrease of 55,000,000 pounds over that in 1924.

"Primary and secondary copper produced by regular refining plants and imported, 1924-1925, in pounds:

"Primary:

Domestic:[a]	*1924*	*1925*
Electrolytic	1,499,223,447	1,533,995,439
Lake	145,333,227	138,029,764
Casting	29,657,925	10,870,144
	1,674,214,599	1,682,895,347
Foreign:[a]		
Electrolytic	577,100,034	516,632,530
Casting	8,761,377	5,045,947
Refinery production of new copper	2,260,076,010	2,204,573,824
Imports of refined copper	145,909,968	99,773,546
Total new refined copper made available	2,405,985,978	2,304,347,370
Secondary:		
Electrolytic	104,281,430	140,340,541
Casting	50,536,678	58,010,653
	154,818,108	198,360,194
	2,560,804,086	2,502,707,564

[a] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation of the amounts at this stage of manufacture is not possible.

"In addition to their output of metallic copper the regular refining companies produced bluestone (hydrous copper sulphate) having a copper content of 6,754,000 pounds, as compared with 5,766,000 pounds in 1924.

---

[1] U. S. Bureau of Mines, Press Bulletin, June 30, 1926.

"STOCKS.

Stocks of Copper. January 1, 1921, 1922, 1923, 1924, 1925 and 1926, in Pounds.

Year.	*Refined copper*	*Blister and material in process of refining* [b]
1921	659,000,000	465,000,000
1922	459,000,000	283,000,000
1923	216,000,000	361,000,000
1924	264,000,000	432,000,000
1925	243,600,000	393,000,000
1926	124,000,000	432,000,000 [a]

[a] Subject to revision. [b] The amounts stated in the last column in the table above do not include copper in stock at foreign smelters or in transit from foreign smelters to refineries in the United States."

Copper Production of California by Years.

Although some mining of copper ores in a small way had been done earlier, shipments in appreciable quantities began in 1861 and continued of importance up to the end of 1867, when a total of 68,631 tons (of 2376 pounds) of high-grade ores, and 847 tons of matte or 'regulus'[1] had been shipped to smelters at New York, Boston, and Swansea, Wales. The most important district at that time was Copperopolis and vicinity in Calaveras County, with some shipments also made from Mariposa, El Dorado, Fresno, and San Luis Obispo counties. From 1868 to 1882, the output was insignificant. There are wide discrepancies in the figures currently recorded for copper production previous to 1882 in which year the data of the U. S. Geological Survey began. The detailed statistics of the California State Mining Bureau began in the year 1894.

Amount and value of copper production in California annually since 1882 is given in the following tabulation:

Year	Pounds	Value	Year	Pounds	Value
1882	826,695	$144,672	1905	16,997,489	$2,650,605
1883	1,600,862	265,743	1906	28,726,448	5,522,712
1884	876,166	120,911	1907	32,602,945	6,341,387
1885	469,028	49,248	1908	40,868,772	5,350,777
1886	430,210	43,021	1909	65,727,736	8,478,142
1887	1,600,000	192,000	1910	53,721,032	6,680,641
1888	1,570,021	235,303	1911	36,838,024	4,604,753
1889	151,505	18,180	1912	34,169,997	5,638,049
1890	23,347	3,502	1913	34,471,118	5,343,023
1891	3,397,405	424,675	1914	30,491,535	4,055,375
1892	2,980,944	342,808	1915	40,968,966	7,169,567
1893	239,682	21,571	1916	55,809,019	13,729,017
1894	738,594	72,486	1917	48,534,611	13,249,948
1895	225,650	21,901	1918	47,793,046	11,805,883
1896	1,992,844	199,519	1919	22,162,605	4,122,246
1897	13,638,626	1,540,666	1920	12,947,299	2,382,303
1898	21,543,229	2,475,168	1921	12,088,053	1,559,358
1899	23,915,486	3,990,534	1922	22,883,987	3,090,582
1900	29,515,512	4,748,242	1923	28,346,860	4,166,989
1901	34,931,788	5,501,782	1924	52,089,349	6,823,704
1902	27,860,162	3,239,975	1925	46,968,499	6,669,527
1903	19,113,861	2,520,997	Totals	982,823,161	[illegible]
1904	29,974,154	3,969,995			

---

[1] Brown, J. Ross, Mineral Resources west of the Rocky Mountains, p. 168, 1867.

GOLD.

Bibliography: State Mineralogist Reports I to XXII (inc.). Bulletins 36, 45, 57, 91, 92. U. S. Geol. Surv., Prof. Paper 73.

Gold was the first, and, for many years, the most important single mineral product of California. Although now surpassed for a number of years in annual value by petroleum, and by cement beginning with 1920, it still heads our metal list, and California continues to outrank all the other gold-producing states of the United States, including Alaska. In fact, at present, California is producing approximately 30% of the gold mined in the entire United States.

While there is some renewal of activity in the development of gold lode properties, it has not yet become reflected in an increased yield of the metal. The 1925 figures show a slight decrease from the 1924 yield, but practically holding its own the past three years.

Lorenz Hydraulic mine, near Weaverville, Trinity County. Photo by C. A. Logan.

The production of gold in California in 1925 totaled 632,035.31 fine ounces, worth $13,065,330, being a decrease of 4,104.41 fine ounces from the 1924 yield. This was divided, $7,969,186 from the 'deep' or lode mines, and $5,096,144 from placers (mainly by the dredgers). As the State Mining Bureau has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Mr. J. M. Hill of the Division of Minerals and Statistics, U. S. Bureau of Mines.

The largest gold production for 1925 is reported from Yuba County, with an output of 124,354.23 fine ounces ($2,570,630); Amador County, with 113,105.63 ounces ($2,338,101), was second; Nevada County, with 111,533.74 ounces ($2,305,607), third; followed by Sierra and Sacramento in fourth and fifth places respectively. It will be noted that Yuba County regained its place in first rank which it surrendered to Nevada County in 1924. The Yuba County production is almost entirely from dredges, while that from Nevada County is mainly lode gold.

Distribution of the 1925 gold production, by counties, was as follows:

Gold Production, by Counties, 1925.

County.	*Value.*	*County.*	*Value.*
Alpine	$219	Nevada	$2,305,607
Amador	2,338,101	Orange	52
Butte	355,289	Placer	121,785
Calaveras	652,433	Plumas	249,540
Del Norte	681	Riverside	3,687
El Dorado	40,212	Sacramento	1,302,320
Fresno	25,056	San Bernardino	157,374
Humboldt	13,142	San Diego	5,134
Inyo	43,774	San Luis Obispo	840
Kern	135,545	Shasta	235,013
Lassen	1,130	Sierra	1,373,705
Los Angeles	409	Siskiyou	180,120
Madera	2,366	Stanislaus	171,742
Mariposa	192,810	Trinity	424,037
Merced	289	Tuolumne	155,592
Mono	5,503	Yuba	2,570,630
Monterey	998		
Napa	195	Total value	$13,065,330

The following is quoted from the advance chapter on Gold in 1925, by courtesy of Mr. J. M. Hill of the U. S. Bureau of Mines:

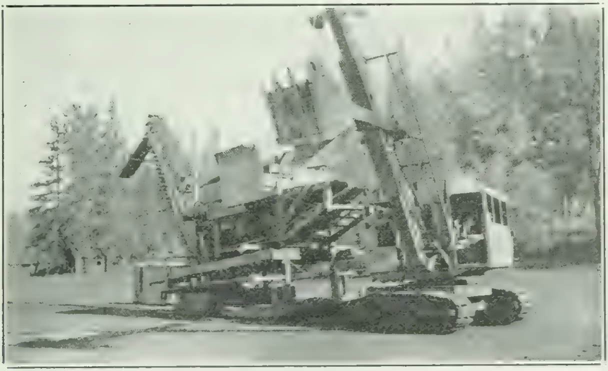
"The value of gold produced in California in 1925 was $13,065,330, a decrease of 0.65 per cent as compared with 1924. Deep mines produced 61 per cent and placer mines 39 per cent of the total gold in 1925 as compared with 65 per cent and 35 per cent respectively, in 1924.

"Five counties produced more than $1,000,000 in gold in 1925. Yuba, with $2,570,630 produced largely by dredges, was first in rank; Amador with $2,338,101 almost entirely from gold quartz mines, was second; Nevada with $2,305,607 from gold quartz and a few placer mines, was third; Sierra with $1,373,705 from gold quartz and hydraulic mines was fourth, and Sacramento with $1,302,320 entirely from placer mines, was fifth. The next largest production of gold, $652,433, came from Calaveras County, largely from gold quartz mines and one dredge operation, followed by Trinity County with $424,037 largely from dredge and hydraulic placer mines.

"In 1925 there were 41 companies in the State that produced in excess of 1,000 ounces of gold and contributed 90 per cent of the total gold output of the State. Of these 8 produced in excess of 20,000 ounces and 4 in excess of 50,000 ounces. Of these companies 12 operated gold dredges, 1 operated a lead and 1 a silver mine, 3 operated copper mines, and 24 operated gold quartz mines. The 10 largest gold-producing companies in 1925, in order of output, were the Yuba Consolidated Gold Fields (6 dredges), Natomas Co. of California (8 dredges), Empire Mines Co. (gold quartz), Sixteen to One Mine Co. (gold quartz), Kennedy Mining & Milling Co. (gold quartz), North Star Mines Co. (gold quartz), Argonaut Mining Co. (gold quartz), Carson Hill Gold Mines (Inc.) (gold quartz), Central Eureka Mining Co. (gold quartz), and the Walker Mining Co. (copper ore).

"The yield of gold from placer mines in 1925 was valued at $5,096,144, an increase of 11 per cent as compared with 1924. There was an increased gold yield of 10 per cent by dredges and 191 per cent by hydraulic mines, but decreases of 33 per cent and 17 per cent by drift and surface mines, respectively, as compared with 1924. In 1925 dredges produced 93 per cent, drift mines slightly over 1 per cent, hydraulic mines nearly 4 per cent, and surface placers 2 per cent of the gold produced from placer deposits. Placer mines of Yuba County increased their gold production by $575,138, Sacramento County by $151,633, Siskiyou County by $33,229, Humboldt County by $11,873, and Nevada County by $10,415, as compared with 1924, and the placer mines of Amador, Mariposa, Placer, and Sierra counties increased their output by more than 3,000 each. There were slight increases in placer yield from Inyo, Plumas, San Diego, and Trinity counties. The gold produced at placer mines declined in Butte County by $193,015, Calaveras County by $40,874, Shasta County by $31,572, and Stanislaus County by $24,277, as compared with 1924. In Fresno, Kern, Madera, and Tuolumne counties there was less placer gold produced than in the previous year. Production of gold by 24 dredges in 1925 was $4,750,842, an increase of $145,321 as compared with 1924. There was an increased production by dredges in Sacramento and Yuba counties, but declines in the gold yield from dredges in Butte, Calaveras, Placer, Shasta, Stanislaus, and Trinity counties. Gold produced at 71 drift mines in 1925 was valued at $66,523, a decrease of $32,045 as compared with 1924. Increases of gold output from drift mines was recorded from El Dorado, Placer, Shasta, Trinity, and Yuba counties, but decreases from drift mines in Butte, Calaveras, Mariposa, Nevada, Plumas, Sierra, and Tuolumne counties. Drift mines in Sacramento County were productive in 1925, but not in 1924. Gold produced at 98 hydraulic mines in 1925 was valued at $175,345, an increase of $115,150 as compared with 1924. The gold production at hydraulic mines increased in Siskiyou County by $31,644, in Trinity County by $25,196, in Sierra County by $18,343, in Nevada County by $15,321, in Humboldt by $12,569, and by less than $10,000 in Amador, Plumas, and Shasta counties. Gold produced by 166 surface or sluice operations in 1925 was valued at $103,434, a decrease of $20,654 as compared with 1924. In practically all the mining counties of the State gold is recovered by itinerant placer prospectors and it is very difficult to apportion properly the gold produced by these floating miners.

"The production of gold from 332 deep mines in California in 1925 was valued at $7,969.186, a decrease of 7 per cent as compared with 1924. The deep mines of Amador and Nevada counties produced over $2,000.000 in gold, of Sierra County over $1,000,000 in gold, of Calaveras County over $500,000 in gold, and of Plumas County over $200,000 in gold. Over $100,000 in gold was produced by deep mines in Mariposa, Shasta, San Bernardino, Tuolumne, Kern, Siskiyou, and Butte counties. Deep mines of Nevada County produced $524,840 less gold, of Amador County $375,401 less gold, and of Calaveras County $160,654 less gold than in 1924. There was a decreased yield of more than $25,000 by the deep mines in Plumas, San Bernardino, Mono, Shasta, and Tuolumne counties. Large increases of value in gold were recorded from deep mines in Sierra County, $569,262, Siskiyou County, $83,321, and Butte County, $63,774. Gold ore and tailings yielded 93 per cent, copper ore and tailings 4 per cent, silver ore and tailings 2 per cent, and lead and zinc ores 1 per cent of the total deep-gold production. Of the gold recovered from ore and tailings in 1925, 72 per cent was recovered by amalgamation, 16 per cent by cyanidation, and 12 per cent by smelting."



P. and H. gasoline steam-shovel and Pierce gravel gold-washing machine on Jenkins & Taylor Placer near French Gulch, Shasta County. Photo by courtesy of Clifford Taylor.

Total Gold Production of California.

The presence of gold in stream gravels near Los Angeles was known and worked in a small way by the Indians, at least as early as 1841,[1] and possibly 1820.[2] On March 2, 1844, Don Manuel Castanares, deputy for California to the Congress of Mexico, reported[3] to his government that placers near Los Angeles had produced up to December, 1843, a total of 2000 ounces of gold dust, most of which had been sent to the United States mint at Philadelphia.

As the padres and the rancheros discouraged the quest of gold this early, small production caused no particular excitement. It was not until James W. Marshall's finding of gold nuggets in the tail-race of Sutter's saw mill on the American River, January 24, 1848, was heralded abroad that the great rush began, and California became a commonwealth of first rank almost over night. There are, however, no authentic data on gold production prior to 1848, other than occasional, scattered references such as above quoted.

---

[1] Hittell, T. H., History of California: Vol. II, p. 312, 1885.
[2] Bancroft, H. H., History of California: Vol. II, p. 417, 1886.
[3] Mercantile Trust Review of the Pacific, Vol. XIV, No. 2, p. 43, Feb. 15, 1925.

The following table was originally compiled by Chas. G. Yale, of the Division of Mineral Resources, U. S. Geological Survey, but for a number of years statistician of the California State Mining Bureau and the U. S. Mint at San Francisco. The authorities chosen for certain periods were: J. D. Whitney, state geologist of California; John Arthur Phillips, author of "Mining and Metallurgy of Gold and Silver" (1867); U. S. Mining Commissioner R. W. Raymond; U. S. Mining Commissioner J. Ross Browne; Wm. P. Blake, Commissioner from California to the Paris Exposition, where he made a report on "Precious Metals" (1867); John J. Valentine, author for many years of the annual report on precious metals published by Wells, Fargo & Company's Express; and Louis A. Garnett, in the early days manager of the San Francisco refinery, where records of gold receipts and shipments were kept. Mr. Yale obtained other data from the reports of the director of the U. S. Mint and the director of the U. S. Geological Survey. The authorities referred to, who were alive at the time of the original compilation of this table in 1894, were all consulted in person or by letter by Mr. Yale with reference to the correctness of their published data, and the final table quoted was then made up.

The figures for 1903–1923 (inclusive), are those prepared by the U. S. Geological Survey; and since by the U. S. Bureau of Mines:

Year	Value	Year	Value
1848	$245,301	1888	$12,750,000
1849	10,151,360	1889	11,212,913
1850	41,273,106	1890	12,309,793
1851	75,938,232	1891	12,728,869
1852	81,294,700	1892	12,571,900
1853	67,613,487	1893	12,538,780
1854	69,433,931	1894	13,863,282
1855	55,485,395	1895	15,334,317
1856	57,509,411	1896	17,181,562
1857	43,628,172	1897	15,871,401
1858	46,591,140	1898	15,906,478
1859	45,846,599	1899	15,336,031
1860	44,095,163	1900	15,863,355
1861	41,884,995	1901	16,989,044
1862	38,854,668	1902	16,910,320
1863	23,501,736	1903	16,300,653
1864	24,071,423	1904	18,633,676
1865	17,930,858	1905	18,898,545
1866	17,123,867	1906	18,732,452
1867	18,265,452	1907	16,727,928
1868	17,555,867	1908	18,761,559
1869	18,229,044	1909	20,237,870
1870	17,458,133	1910	19,715,440
1871	17,477,885	1911	19,738,908
1872	15,482,194	1912	19,713,478
1873	15,019,210	1913	20,406,958
1874	17,264,836	1914	20,653,496
1875	16,876,009	1915	22,442,296
1876	15,610,723	1916	21,410,741
1877	16,501,268	1917	20,087,504
1878	18,839,141	1918	16,528,953
1879	19,626,654	1919	16,695,955
1880	20,030,761	1920	14,311,043
1881	19,223,155	1921	15,704,822
1882	17,146,416	1922	14,670,346
1883	24,316,873	1923	13,379,013
1884	13,600,000	1924	13,150,175
1885	12,661,044	1925	13,065,330
1886	14,716,506		
1887	13,588,614	Total value	$1,789,298,515

IRIDIUM (see under Platinum).

IRON ORE.

Bibliography: State Mineralogist Reports II, IV, V, X, XII–XV (inc.), XVII, XVIII, XXI. Bulletins 38, 67, 91. Am. Inst. Min. Eng., Trans. LIII. Min. & Sci. Press, Vol. 115, pp. 112, 117–122; Vol. 123, pp. 94–96, 113–114.

A small tonnage of iron ore was produced in California during the year 1925, and utilized for foundry flux and in steel refining at open-hearth plants. As there was only a single operator, the figures are concealed under the 'unapportioned' total. There is also some tonnage utilized in the manufacture of paint pigment, and which is credited to 'mineral paint' in these statistical reports.

There are considerable deposits of iron ore known in California, notably in Shasta, Madera, Placer, Riverside and San Bernardino counties, but production has so far been limited for lack of an economic supply of coking coal. Some pig-iron has been made, utilizing charcoal for fuel, both in blast furnaces and by electrical reduction; also, ferrochrome, ferromanganese, and ferrosilicon have been made in California.

Total Iron Ore Production of California.

Total iron ore production in California, with annual amounts and values, is as follows:

Year	Tons	Value
1881*	9,273	$79,452
1882	2,073	17,766
1883	11,191	106,540
1884	4,532	40,983
1885	----	----
1886	3,676	19,250
1887	----	----
1893	250	2,000
1894	200	1,500
1895	----	----
1907	400	400
1908	----	----
1909	108	174
1910	579	900
1911	558	558
1912	2,508	$2,508
1913	2,343	4,485
1914	1,436	5,128
1915	724	2,584
1916	3,000	6,000
1917	2,874	11,496
1918	3,108	15,947
1919	2,300	13,796
1920	5,975	40,889
1921	1,970	12,030
1922	3,588	18,868
1923	3,102	18,665
1924 1925 [a]	785	4,710
Totals	66,533	$526,629

*Productions for the year 1881-1886 (inc.) were reported as "tons of pig iron" (U. S. G. S., Min. Res. 1885), and for the table herewith are calculated to "tons of ore" on the basis of 47.6% Fe as shown by an average of analyses of the ores (State Mineralogist Report IV, p. 242). This early production of pig iron was from the blast furnaces then in operation at Hotaling in Placer County. Charcoal was used in lieu of coke. Though producing a superior grade of metal, they were obliged finally to close down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

[a] Annual details concealed under 'Unapportioned.'

LEAD.

Bibliography: State Mineralogist Reports IV, VIII-XV (inc.), XVII-XXII (inc.).

Production of lead in California in 1925 increased approximately 40% in quantity and 60% in value over the preceding year. As in the past, the principal output was from lead-silver ores in Inyo County. The total recoverable lead in ores shipped from Californian mines in

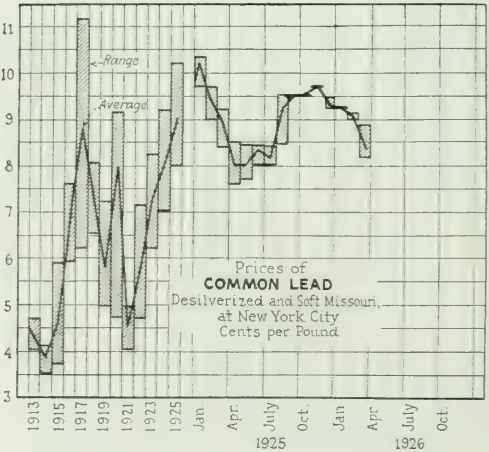
1925 amounted to 7,352,422 pounds valued at $639,661, compared with 4,984,387 pounds and $398,751 in 1924. This, in turn, however, was slightly less than the 1923 yield. The average price of lead in 1925 was 8.7¢ per pound as against 8.0¢ in 1924, 7.0¢ in 1923, and 3.9¢ in 1913.

The 1925 lead production was distributed by counties as follows:

Lead Production, by Counties, 1925.

County.	*Pounds.*	*Value.*
Inyo	6,301,105	$548,196
Mono	22,488	1,957
Riverside	135,872	11,821
San Bernardino	61,480	5,349
Shasta	647,886	56,366
Amador, Butte, Calaveras, Los Angeles, Nevada, Orange*	183,591	15,972
Totals	7,352,422	$639,661

*Combined to conceal output of a single operator in each.



From Engineering and Mining Journal-Press, April 3, 1926.

Lead Production of California, by Years.

Statistics on lead production in California were first compiled by this Bureau in 1887. Amount and value of the output, annually, with total figures, to date, are given in the following table:

Year	Pounds	Value	Year	Pounds	Value
1887	1,160,000	$52,200	1908	1,124,483	$46,663
1888	900,000	38,250	1909	2,685,477	144,897
1889	940,000	35,720	1910	3,016,902	134,082
1890	800,000	36,000	1911	1,403,839	63,173
1891	1,140,000	49,020	1912	1,370,067	61,653
1892	1,360,000	54,400	1913	3,640,951	160,202
1893	666,000	24,975	1914	4,697,400	183,198
1894	950,000	28,500	1915	4,796,299	225,426
1895	1,592,400	49,364	1916	12,392,031	855,049
1896	1,293,500	38,805	1917	21,651,352	1,862,016
1897	596,000	20,264	1918	13,464,869	956,006
1898	655,000	23,907	1919	4,139,562	219,397
1899	721,000	30,642	1920	4,903,738	392,300
1900	1,040,000	41,600	1921	1,149,051	51,707
1901	720,500	28,820	1922	6,511,280	358,120
1902	349,440	12,230	1923	9,934,522	695,416
1903	110,000	3,960	1924	4,984,387	398,751
1904	124,000	5,270	1925	7,352,422	639,661
1905	533,680	25,083			
1906	338,718	19,307			
1907	328,681	16,690	Totals	125,537,551	$8,082,724

MANGANESE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVIII. Bulletins 38, 67, 76, 91. U. S. G. S., Bull. 427. Eng. & Min. Jour.-Press, Vol. 117, p. 545.

Manganese ore shipments in California in 1925 amounted to a total of 532 tons of all grades valued at $11,500, being a decrease both in quantity and value from the 1924 yield which totaled 1115 tons and $25,785 value. These ores showed analyses of from 45% to 55% Mn, and were utilized by Pacific Coast plants for ferromanganese.

Importations of foreign manganese ores in 1925, mainly from Brazil, amounted to a total of 291,662 long tons valued at $7,966,688, compared with 254,458 tons and $6,036,760 in 1924. The Tariff Act of 1922 provides for an import duty of 1¢ per pound on the metallic manganese contained, for "manganese ore or concentrates containing in excess of 30 per centum of metallic manganese." The bulk of such ore is consumed in the large steel-producing centers of the eastern United States.

Manganese Ore Production in California, by Years.

Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5000 tons had been produced by that property. For some years following that, the output was small. The tabulation herewith shows California's output of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1907	1	$25
1888	1,500	13,500	1908	321	5,785
1889	53	901	1909	3	75
1890	386	3,176	1910	265	4,235
1891	705	3,830	1911	2	40
1892	300	3,000	1912	22	400
1893	270	4,050	1913	------	------
1894	523	5,512	1914	150	1,500
1895	880	8,200	1915	4,013	49,098
1896	518	3,415	1916	13,404	274,601
1897	504	4,080	1917	15,515	396,659
1898	440	2,102	1918	26,075	979,235
1899	295	3,165	1919	11,569	451,422
1900	131	1,310	1920	2,892	62,323
1901	425	4,405	1921	1,005	12,210
1902	870	7,140	1922	540	7,650
1903	1	25	1923	690	10,620
1904	60	900	1924	1,115	[illegible]
1905	------	------	1925	532	11,500
1906	1	30	Totals	86,976	$2,370,904

MOLYBDENUM.

Bibliography: State Mineralogist Reports XIV, XVII. Bulletins 67, 91. U. S. Bur. of Min., Bulletin 111. Proc. Colo. Sci. Soc., Vol. XI.

Molybdenum is used as an alloy constituent in the steel industry, and in certain forms of electrical apparatus. Included in the latter is its successful substitution for platinum and platinum-iridium in electric contact-making and -breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel, tungsten, and vanadium. The oxides and the ammonium salt have important chemical uses.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate; the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as granite and pegmatite. The chief commercial sources have been New South Wales, Queensland, and Norway, with some also from Canada; but the United States is now able to supply its own requirements.

The growing consumption of molybdenum by alloy-steel makers in the United States has been stimulated by the fact that molybdenum alone of the steel-alloying metals can be produced commercially in the United States to an extent which avoids all necessity for importation. Another fact has been the marked adaptability of molybdenum steels to large-scale production of automobile and other parts.

The most important development of 1924-1925 was the elimination of ferromolybdenum from the market due to the substitution of calcium molybdate as the furnace addition by the entire alloy-steel industry. Calcium molybdate is stated to be not only easier and less costly to prepare, but it introduces the molybdenum into the steel bath in a much purer form, the resulting steel being superior to that made with ferromolybdenum.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. The only recorded commercial shipments of molybdenum ore in California were during the war, 1916–1918. Some development work has been recently done on a high-grade deposit at the head of the Kaweah River, Tulare County.

Present quotations for molybdenum ore are 55¢ per pound for 85% MoS_2 concentrates.

Molybdenum Production of California, by Years.

California's production of molybdenum ore by years is summarized in the following tabulation:

Year	*Tons*	*Value*
[illegible]	8	$9,945
[illegible]	[illegible]	[illegible]
[illegible]	*	[illegible]
[illegible]	[illegible]	[illegible]

*300 pounds of 90% MoS_2 concentrate.

NICKEL.

Bibliography: State Mineralogist Reports XIV, XVII. U. S. G. S., Bulletin 640–D. U. S. Bureau of Standards, Circular 100.

Nickel occurs in the Friday Copper Mine in the Julian District, San Diego County. The ore is a nickel-bearing pyrrhotite, with some associated chalcopyrite. Some ore has been mined in the course of development work, but not treated nor disposed of, as they were unable to get any smelter to handle it for them. Nickel ore has also been reported from other localities in California, but not yet confirmed.

Present quotations for nickel are around 35¢–36¢ per pound for the refined metal.

OSMIUM (see under Platinum).

PALLADIUM (see under Platinum).

PLATINUM.

Bibliography: State Mineralogist Reports IV, VIII, IX, XII–XVIII. Bulletins 38, 45, 67, 85, 91, 92. U. S. Geol. Surv. Bulletins 193, 285. Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217–218.

In California platinum is obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Calaveras, Sacramento, Stanislaus, and Yuba counties, with smaller amounts from the hydraulic and surface-sluicing mines of Del Norte, Humboldt, Shasta, Siskiyou, and Trinity.

The production of platinum-group metals in California for the year 1925 totaled 355 ounces, crude, containing 292 fine ounces, valued at $39,937. Of this amount, a total of 307 ounces, crude, or 86%, came from the gold dredges. This is a slight increase over the 273 fine ounces worth $36,452 sold in 1924.

The above-noted total of 292 fine ounces includes 120 fine ounces of iridium, osmiridium, ruthenium, and palladium. Most of the platinum refiners pay for the osmiridium on the basis of its iridium content.

Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, osmiridium or iridosmine, with occasionally some ruthenium and palladium. In addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the mint, but which can not be assigned to the territory of its origin for lack of knowing to which lots of gold it belongs. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

For 1925, the distribution by counties of California's platinum yield was as follows:

Platinum Production, by Counties, 1925.

County	*Fine ounces*	*Value*
Butte	[a] 56	$9,177
Shasta	8	725
Trinity	26	3,081
Calaveras, Del Norte, Humboldt, Sacramento,[a] Siskiyou, Stanislaus, Yuba [b] *	202	26,954
Totals	292	$39,937

[a] Includes ruthenium and palladium.
[b] Includes palladium.
* Combined to conceal output of a single operator in each.

Uses, Markets, and Consumption.

Besides its well-known uses in jewelry, dentistry and for chemical-ware, an important industrial development of recent years employs platinum as a catalyzer in the 'contact process' of manufacturing concentrated sulphuric acid. It is also necessary for certain delicate parts of the ignition systems in automobiles, motor boats and aeroplanes. Experiments have been made to find alloys which can replace platinum for dishes and crucibles in analytical work, but so far with only slight success.

According to Hill,[1] the total consumption of platinum metals in the United States in 1925 was 137,345 troy ounces, an increase over that consumed in 1924, distributed as follows:

"Platinum metals consumed in the United States as reported by refiners, 1924 and 1925, by industries, in troy ounces

Industry	Platinum	Palladium	Iridium	Others	Total	Percentage of total
1924						
Chemical	10,507	436	122	403	11,468	7
Electrical	16,588	3,099	1,269		20,956	13
Dental	11,092	10,049	131		21,272	13
Jewelry	87,151	12,480	2,204	746	102,581	62
Miscellaneous	5,012	2,122	634	973	8,741	5
Totals	130,350	28,186	4,360	2,122	165,018	100
1925						
Chemical	12,558	383	71	685	13,697	8
Electrical	18,845	3,157	1,579	111	23,692	13
Dental	9,293	14,952	95		24,340	14
Jewelry	93,293	10,950	2,840	2,280	109,363	62
Miscellaneous	3,356	520	220	1,414	5,510	3
Totals	137,345	29,962	4,805	4,490	176,602	100

---

[1] Hill, J. M., Refined platinum and allied metals in 1925: U. S. Bur. of Mines, Press Bull., April 29, 1926.

"Stocks.

"At the end of 1925 stocks of crude platinum metals in the hands of refiners were 79,093 ounces, an increase of 4554 ounces as compared with stocks on hand December 31, 1924.

"Stocks of platinum metals in hands of refiners in the United States December 31, 1921-1925, in troy ounces.

Year	Platinum	Palladium	Iridium	Others	Total
1921	38,514	21,042	4,991	3,113	67,660
1922	41,900	24,975	7,559	1,583	76,017
1923	36,554	26,266	5,208	2,697	70,725
1924	40,464	27,400	3,622	3,053	74,539
1925	44,024	26,740	3,720	4,609	79,093

Platinum Production of California, by Years.

The annual production and value since 1887, have been as follows:

Year	Ounces	Value	Year	Ounces	Value
1887	100	$400	1907	300	$6,255
1888	500	2,000	1908	706	13,414
1889	500	2,000	1909	416	10,400
1890	600	2,500	1910	337	8,386
1891	100	500	1911	521	14,873
1892	80	440	1912	603	19,731
1893	75	517	1913	368	17,738
1894	106	600	1914	463	14,816
1895	150	900	1915	667	21,149
1896	162	944	1916	886	42,642
1897	150	900	1917	619	43,719
1898	300	1,800	1918	571	42,788
1899	300	1,800	1919	*418	50,611
1900	400	2,500	1920	477	68,977
1901	250	3,200	1921	613	58,754
1902	39	468	1922	795	90,288
1903	70	1,052	1923	602	78,546
1904	123	1,849	1924	273	36,452
1905	200	3,320	1925	292	39,937
1906	91	1,647	Totals	14,192	$718,813

*Fine ounces, beginning with 1919.

QUICKSILVER.

Bibliography: State Mineralogist Reports IV, V, XII–XV, XVII–XXII (inc.). Bulletins 27, 78, 91. U. S. Geol. Surv., Monograph XIII. U. S. Bur. of Mines, Tech. Papers 96, 227; Bulletin 222.

Quicksilver was produced in California in seven counties during 1925 to the amount of 7683 flasks (of 75 pounds, avoirdupois) valued at $621,831, being a slight decrease in quantity but an increase in value compared with the 1924 output of 7948 flasks worth $543,080. This was due to improved prices. The average price received during 1925, according to the producers' reports to the State Mining Bureau, was $80.81 per flask, as against $68.33 in 1924 and the record average of $114.03 for the year 1918.

The average of San Francisco quotations for 1925 was $82.60 per flask, the price ranging without sharp fluctuations between $79.90 and

$82.83 from January 1st until the end of October. Beginning with November the quotations advanced sharply to $85.17 and to a maximum of $91.67, closing the year at $90.17. Thus far for 1926, San Francisco quotations have ranged between $88 and $90 per flask. The average of quotations for 1925 in New York was $83.13 per flask.

The above-noted yield of 7683 flasks in 1925 was won from a total of 59,797 tons of ore, being an average content of 9.64 pounds per ton, or 0.482% mercury.

The U. S. Bureau of Mines reports the total production of the United States for 1925 at 9174 flasks valued at $762,616 (using $83.128 as the average of New York quotations). Outside of California, the principal yield was from Texas, with a few flasks from Nevada, Arizona, and Idaho. California's contribution was 84% of the total.

The imports of quicksilver in 1925 amounted to 11,245 flasks from Italy and 9754 flasks from Spain, and from all other countries 1782 flasks, making a total of 22,781 flasks. The exports were 204 flasks.

The 1925 quicksilver production in California was distributed, by counties, as follows:

County.	*Flasks.*	*Value.*
San Benito	6,085	$486,797
Sonoma	351	29,134
Kings. Monterey, Napa, San Luis Obispo, Santa Clara*	1,247	105,900
Totals	7,683	$621,831

*Combined to conceal output of a single operator in each.

Uses.

The most important uses of quicksilver are the recovery of gold and silver by amalgamation, and in the manufacture of fulminate for explosive caps, of drugs, of electric appliances, and of scientific apparatus. By far the greatest consumption is in the manufacture of fulminate and drugs.

Gould [1] states:

> "Consumption of the metal in this country continues to increase, principally in the electrical and allied industries. Although accurate data are not available, the United States will probably consume nearly 45,000 flasks of mercury in 1926, or about one-half of the world's production. This is twice the pre-war consumption, and each year shows a heavy increase. European advices indicate an increased demand for the metal on the continent, especially in Germany. For ten years prior to 1914, Germany was the world's largest market for quicksilver, and that country will probably again become a large consumer."

Total Quicksilver Production of California.

Total amount and value of the quicksilver production of California, as given in available records, is shown in the following tabulation. Though the New Almaden Mine in Santa Clara County was first worked in 1924, and has been in practically continuous operation since 1846 (the yield being small the first two years), there are no available data on the output earlier than 1850. Previous to June, 1904, a 'flask' of quicksilver contained 76½ pounds, but since that date 75 pounds. In compiling this table the following sources of information were used: for 1850–1883, table by J. B. Randol, in Report of State Mineralogist, IV, p. 336; 1883–1893, U. S. Geological Survey reports; 1894 to date, statistical bulletins of the State Mining Bureau; also State Mining Bureau, Bulletin 27, "Quicksilver Resources of California," 1908, p. 10:

---

[1] Gould, H. W., Quicksilver: Eng. and Min. Jour-Press, Vol. 121, p. 91, Jan. 16, 1926.

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1889	26,464	$1,190,880	$45 00
1851	27,779	1,859,248	66 93	1890	22,926	1,203,615	52 50
1852	20,000	1,166,600	58 33	1891	22,904	1,036,406	45 25
1853	22,284	1,235,648	55 45	1892	27,993	1,139,595	40 71
1854	30,004	1,663,722	55 45	1893	30,164	1,108,527	36 75
1855	33,000	1,767,150	53 55	1894	30,416	934,000	30 70
1856	30,000	1,549,500	51 65	1895	36,104	1,337,131	37 04
1857	28,204	1,374,381	48 73	1896	30,765	1,075,449	34 96
1858	31,000	1,482,730	47 83	1897	26,691	993,445	37 28
1859	13,000	820,690	63 13	1898	31,092	1,188,626	38 23
1860	10,000	535,500	53 55	1899	29,454	1,405,045	47 70
1861	35,000	1,471,750	42 05	1900	26,317	1,182,786	44 94
1862	42,000	1,526,700	36 35	1901	26,720	1,285,014	48 46
1863	40,531	1,705,544	42 08	1902	29,552	1,276,524	43 20
1864	47,489	2,179,745	45 90	1903	32,094	1,335,954	42 25
1865	53,000	2,432,700	45 90	1904	*28,876	1,086,323	37 62
1866	46,550	2,473,202	53 13	1905	24,655	886,081	35 94
1867	47,000	2,157,300	45 90	1906	19,516	712,334	36 50
1868	47,728	2,190,715	45 90	1907	17,379	663,178	38 16
1869	33,811	1,551,925	45 90	1908	18,039	763,520	42 33
1870	30,077	1,725,818	57 38	1909	16,217	773,788	47 71
1871	31,686	1,999,387	63 10	1910	17,665	799,002	45 23
1872	31,621	2,084,773	65 93	1911	19,109	879,205	46 01
1873	27,642	2,220,482	80 33	1912	20,600	866,024	42 04
1874	27,756	2,919,376	105 18	1913	15,661	630,042	40 23
1875	50,250	4,228,538	84 15	1914	11,373	557,846	49 05
1876	75,074	3,303,256	44 00	1915	14,199	1,157,449	81 52
1877	79,396	2,961,471	37 30	1916	21,427	2,003,425	93 50
1878	63,880	2,101,652	32 90	1917	24,382	2,396,466	98 29
1879	73,684	2,194,674	29 85	1918	22,621	2,579,472	114 03
1880	59,926	1,857,706	31 00	1919	15,200	1,353,381	89 04
1881	60,851	1,815,185	29 83	1920	10,278	775,527	75 45
1882	52,732	1,488,624	28 23	1921	3,157	140,666	44 56
1883	46,725	1,343,344	28 75	1922	3,466	191,851	55 35
1884	31,913	973,347	30 50	1923	5,458	332,851	60 98
1885	32,073	986,245	30 75	1924	7,948	543,080	68 33
1886	29,981	1,064,326	35 50	1925	7,683	621,831	80 81
1887	33,760	1,430,749	42 38				
1888	33,250	1,413,125	42 50	Totals	2,213,539	$108,531,119	-------

*Flasks of 75 lbs. since June, 1904; of 76½ lbs. previously.

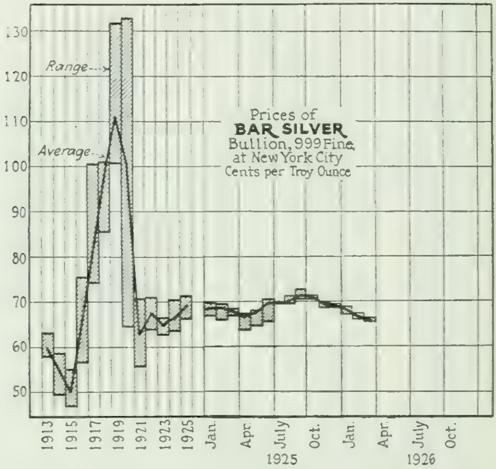
SILVER.

Bibliography: State Mineralogist Reports IV, VIII, XII–XXII (inc.). Bulletins 67, 91. Min. & Sci. Press, March 1, 1919.

Except for the early-day production from the silver mines of the Calico district and the more recent production from those of the Randsburg area, both of which are in San Bernardino County, the recovery of silver in California has been largely as a by-product from its association with copper, lead, zinc, and gold ores.

The 1925 silver output of California totaled 3,054,416 fine ounces, valued at $2,106,871 compared with 3,555,153 fine ounces valued at

$2,381,952 in 1924. Of the 1925 yield, $12,894 was from placers. The average price of domestic silver during 1925 was 69.4¢ per ounce in New York, as against 67¢ in 1925, and $1.00 in 1921–1923 under the Pittman Act. The figures below are those of the U. S. Bureau of Mines, Department of Commerce (as explained under Gold).



From Engineering and Mining Journal-Press, April 3, 1926.

The distribution of the 1925 silver yield, by counties, was as follows:

Silver Production, by Counties, 1925.

County.	Fine ounces.	Value.	County.	Fine ounces.	Value.
Alpine	2	$1	Nevada	46,333	32,155
Amader	23,232	16,123	Orange	1,433	995
Butte	6,274	4,354	Placer	893	620
Calaveras	11,994	8,324	Plumas	423,997	294,254
Del Norte	2	1	Riverside	3,703	2,570
El Dorado	343	238	Sacramento	2,767	1,920
Fresno	217	151	San Bernardino	1,986,155	1.378,392
Humboldt	90	62	San Diego	83	58
Inyo	169.688	117,763	San Luis Obispo	10	7
Kern	10,742	7,455	Shasta	300,890	208.818
Lassen	34	24	Sierra	12,852	8,919
Los Angeles	22,254	15.444	Siskiyou	1,198	831
Madera	118	82	Stanislaus	1,000	694
Mariposa	2,533	1,758	Trinity	11.129	7.724
Merced	2	1	Tuolumne	885	614
Mono	2,291	1,590	Yuba	9,222	6,400
Monterey	4	3			
Napa	2,046	1,420	Totals	3,054,416	$2,119,765

The following paragraphs are quoted from the U. S. Bureau of Mines, Department of Commerce, Advance Chapter on Gold and Silver for 1925, by courtesy of Mr. J. M. Hill, statistician in charge of the San Francisco branch office:

"The production of silver in 1925 was 3,054,416 ounces, valued at $2,119,765, a decrease of 14 per cent in quantity and 11 per cent in value as compared with 1924. Four counties produced over 100,000 ounces of silver in 1925, namely, San Bernardino with 1,986,155 ounces largely from silver ore produced by the California Rand

Silver (Inc.), Plumas County with 423,997 ounces largely produced from copper ores of the Engels and Walker mines, Shasta County with 300,890 ounces largely from copper and zinc ores, and Inyo County with 169,688 ounces, most of which was from lead ores. The next largest silver production was 46,333 ounces from Nevada County gold ores, followed by 23,232 ounces from Amador County gold ores.

"The yield of silver from placer mines in 1925 was 18,579 ounces, an increase of 11 per cent as compared with 1924 and 0.61 per cent of the total silver output of the State. Of the 3,035,837 ounces of silver produced at deep mines in 1925, silver ore and tailings yielded 66 per cent, copper ore and tailings 23 per cent, lead ore 6 per cent, zinc ore and lead-zinc ore each 1 per cent, and gold ore and tailings 3 per cent. There were decreases in production of silver in all the more important silver-producing counties except Plumas, which increased its production of silver by 54,491 ounces. San Bernardino County produced 299,812 ounces less, Shasta County 211,651 ounces less, and Inyo County 3,146 ounces less silver than in 1924.

"Silver production at 45 properties was in excess of 1,000 ounces in 1925 and these mines yielded 98 per cent of the total silver produced in the State. At 30 properties the yield was between 1,000 and 10,000 ounces, at 11 between 10,000 and 60,000, at 3 between 100,000 and 300,000, and at 1 mine in excess of 1,000,000 ounces in 1925. The 10 largest silver producers in 1925, in order of output, were the California Rand Silver (Inc.), U. S. Smelting, Refining & Mining Co. (Mammoth mines), Walker Mining Co., Engels Copper Mining Co., Tecopa Consolidated Mining Co., Shorey Tailings Plant, Mulcahy Bros., Cerro Gordo Mines Co., California Zinc Co., and the Empire Mines Co."

Silver Production of California, by Years.

The amount and value of the silver production of California, and the average price, annually, since 1880 are given in the table following. In the table shown in the statistical bulletins previous to this present Bulletin 97 (for 1925), the values shown for 1880-1904 (inc.) were taken from the reports of the Director of the Mint, of which the figures for 1880-1896 (inc.) were based on 'coinage value' ($1.2929 per fine ounce). We have recalculated these to commercial value, using the price table of the U. S. Geological Survey (McCaskey, H. D., Gold and Silver, 1913: Mineral Resources of the U. S., Part I, p. 847). From 1905 to date, the figures are those of the U. S. Geological Survey and its successor, the U. S. Bureau of Mines.

Year	Fine oz.	Value	Average price per oz.	Year	Fine oz.	Value	Average price per oz.
1880	882,169	$1,014,494	$1 15	1904	1,441,259	$835,929	58
1881	580,091	655,503	1 13	1905	1,076,174	650,009	61
1882	653,569	745,069	1 14	1906	1,220,641	817,830	68
1883	1,129,244	1,253,461	1 11	1907	1,138,856	751,646	66
1884	3,236,987	3,593,056	1 11	1908	1,647,278	873,057	53
1885	1,986,260	2,125,298	1 07	1909	2,098,253	1,091,092	52
1886	1,245,747	1,233,290	0 99	1910	1,840,085	993,646	54
1887	1,262,282	1,237,036	0 98	1911	1,270,445	673,336	53
1888	1,314,874	1,235,982	0 94	1912	1,300,136	799,584	615
1889	823,947	774,510	0 94	1913	1,378,399	832,553	604
1890	820,336	861,353	1 05	1914	1,471,859	813,938	553
1891	737,224	729,852	0 99	1915	1,678,756	851,129	507
1892	358,575	311,960	87	1916	2,564,354	1,687,345	658
1893	415,468	324,065	78	1917	1,775,431	1,462,955	824
1894	229,896	144,834	63	1918	1,427,711	1,427,711	1 00
1895	463,911	301,542	65	1919	1,107,189	1,240,051	1 12
1896	326,757	222,195	68	1920	1,706,327	1,859,896	1 09
1897	754,648	452,789	60	1921	3,629,223	3,629,223	1 00
1898	701,788	414,055	59	1922	3,100,065	3,100,065	1 00
1899	855,869	513,521	60	1923	3,559,443	2,918,743	82
1900	1,168,157	724,257	62	1924	3,555,133	2,381,952	67
1901	950,831	570,499	60	1925	3,054,416	2,119,765	694
1902	1,163,041	616,412	53				
1903	958,230	517,444	54	Totals	66,061,334	$52,383,932	

TIN.

Bibliography: Reports XV, XVII, XVIII. Bulletins 67, 91.

Tin is not at present produced in California; but during 1891–1892, there was some output from a small deposit near Corona, in Riverside County, as tabulated below. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

Two occurrences have also been noted, in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite and beryl. No commercial quantity has been developed, only small pockets have been taken out.

The principal sources of the world's supply of tin are the islands of Banka, Billiton and Singkep, Netherlands India (Dutch East Indies), followed by the Federated Malay States (Perak, Pahang, Negri Sembilan and Selangor). Bolivia, Siam, Cornwall, Transvaal, New South Wales, Queensland and Tasmania are also important sources. A measurable amount of the metal is also recovered by detinning scrap and old cans. A recent press bulletin (July 23, 1926) of the U. S. Bureau of Mines states that more than 1000 long tons of old tin cans were detinned in 1925, yielding a recovery of nearly 25 pounds of tin per ton of cans.

Total Output of Tin in California.

Year	*Pounds*	*Value*
1891	125,289	$27,564
1892	126,000	32,400
Totals	251,289	$59,964

TUNGSTEN.

Bibliography: Reports XV, XVII, XVIII. Bulletins 38, 67, 91, 95. U. S. G. S. Bull. 652. Proc. Colo. Sci. Soc. Vol. XI. South Dakota School of Mines, Bulletin No. 12. Eng. and Min. Jour.-Press, Vol. 113, pp. 666–669, Apr. 22, 1922.

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920–1922 (inclusive), when the mines were shut down owing to low prices due to excess stocks following the war and to lack of tariff protection against foreign importations. Production was resumed on a small scale late in 1923, and has now practically regained its pre-war average annual tonnage, though the 1925 figures are about 25 per cent less than those for 1924.

The material shipped in 1925 included both high-grade sorted ore and concentrates, coming from properties in Inyo and San Bernardino counties. A total of 8619 tons of all grades was reported produced, and in part concentrated, yielding 573 tons recalculated to 60% WO_3, valued at a total of $348,471.

Prices during 1925 ranged rather regularly from $9 per unit, duty paid, for Chinese wolframite in January, to $12 in December; with domestic scheelite commanding 50¢ to $1 per unit higher. Present (May, 1926) prices are $11.75 to $12.75 with domestic demand light, though curtailment of Chinese supplies is anticipated.

Tungsten ore has been produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, followed by the Bishop district in Inyo County, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of the California tungsten ore is scheelite (calcium tungstate), though wolframite (iron-manganese tungstate) and hübernite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known,[1] and the output has in some years equaled or exceeded that of ferberite (iron tungstate) from Boulder County, Colorado. It is interesting in this connection to note that, in practically all other tungsten producing districts of the world, wolframite is the important constituent.

---

[1] U. S. G. S., Bull. 652, p. 32.

Imports of foreign tungsten ore and alloys into the United States during 1925 amounted to 3,089,589 pounds, valued at $735,108, compared with 79,595 pounds valued at $24,981 in 1924, and 10,362 long tons of ore valued at $11,409,237 in 1918, which ores were duty free up to September 22, 1922. Owing to lack of protection against the cheap coolie labor of Asiatic tungsten mines, and the low market prices, practically all of the tungsten mines in the United States were closed down from the middle of 1919 to the latter part of 1923. Quotations during 1922 ranged around $2.50 per unit, up to September. The Tariff Act of 1922 placed a duty on tungsten ore or concentrates of 45¢ per pound on the metallic tungsten contained therein. Duties are also provided for imported tungsten-bearing alloys.

Uses.

The metal, tungsten, is used mainly in the steel industry and in the manufacture of electrical appliances, including the well-known tungsten filament lamps. Because of its resistance to corrosion by acids, it is valuable in making certain forms of chemical apparatus. Its employment in tool-steel alloys permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would lose its temper—hence the name 'high speed' steels for these tungsten alloys. As made in the United States, tungsten forms 13% to 20% of such steels. Some chromium, nickel, cobalt, or vanadium are sometimes also included. Tungsten compounds are used in the manufacture of colors.

Tungsten is introduced into the molten steel charge, either as the powdered metal or as ferro-tungsten (containing 50%–85% tungsten). The specific gravity of the pure metal, 19.3–21.4, is exceeded only by platinum, 21.5; iridium, 22.4; and osmium, 22.5. Its melting point is 3267° C. (5913° F.), being higher than any other known metal. Though millions of tungsten filament lamps are now made, the wires are so fine that the metal they contain represents but a few tons of tungsten concentrates annually.

Total Tungsten Ore Production of California.

The annual amount and value of tungsten ores and concentrates produced in California since the inception of the industry is given herewith, with tonnages recalculated to 60% WO_3:

Year	Tons at 60% WO_3	Value	Year	Tons at 60% WO_3	Value
1905	57	$18,800	**1916**	**2,270**	$4,571,521
1906	485	189,100	1917	2,466	3,079,013
1907	287	120,587	1918	1,982	2,832,222
1908	105	37,750	1919	214	219,316
1909	577	190,500	1920	----------	----------
1910	457	208,245	1923	34	19,126
1911	387	127,706	1924	781	446,009
1912	572	206,000	1925	573	348,475
1913	559	234,673			
1914	420	180,575	Totals	13,188	$14,035,081
1915	**962**	1,005,467			

VANADIUM.

Bibliography: Report XV. Bulletins 67, 91. Proc. Colo. Sci. Soc., Vol. XI. U. S. Bur. of Mines, Bulletin 104.

No commercial production of vanadium has yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs, in San Bernardino County, and two companies at one time did considerable development work in the endeavor to open up paying quantities. Each had a mill under construction in 1916, but apparently no commercial output was made. Ore carrying the mineral cuprodescloizite and reported as assaying 4% V_2O_5 was opened up. Some ore carrying lead vanadate has been developed in the 29 Palms, or Washington district, on the line between Riverside and San Bernardino counties, but no shipments reported.

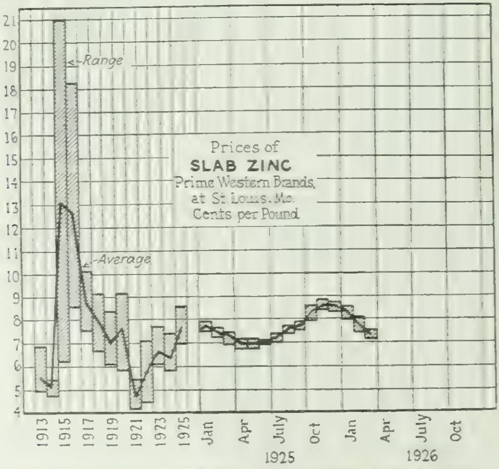
The principal use of vanadium is as an alloy in steels, especially in tool steel, and in those varieties where resistance to repeated strains is required. Present New York quotations for vanadium ore are @ 60¢–65¢ per pound of contained V_2O_5 (carrying 12%–18% V_2O_5).

ZINC.

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XX, XXII. Bulletins 38, 67, 91.

Recoverable zinc in ores mined in California in 1925 amounted to 11,546,602 pounds valued at $877,542, compared with 3,060,000 pounds and $198,900 in 1924. The 1924 output was marketed entirely in the form of the oxide; but the major portion of the 1925 yield (in the form of concentrates) was shipped to Belgium for treatment. A small amount of oxide was marketed.

The average price per pound quoted for the metal in 1925 was 7.6¢ as against 6.5¢ in 1924.



From Engineering and Mining Journal-Press, April 3, 1926.

The zinc ores of Shasta and Calaveras counties are associated with copper, while those of Inyo and San Bernardino are associated principally with lead-silver and zinc-silver ores.

The principal uses of zinc are for 'galvanizing' (plating on iron to prevent rust), for zinc oxide (used in rubber goods and paint), and for brass (an alloy of copper and zinc). These outlets for the metal take approximately 80% of the quantity produced. Of the remaining 20% a large portion is rolled into plates and sheets, and utilized in the building industry for sheathing, roofing, leaders, and eaves-troughs. Zinc is particularly desirable and efficient for roofing and siding where corrosive gases are present, as at smelters, refineries and chemical plants.

Total Zinc Production of California.

Total figures for zinc output of the state are as follows, commercial production dating back only to 1906:

Year	Pounds	Value	Year	Pounds	Value
1906	206,000	$12,566	1917	11,854,804	$1,209,190
1907	177,759	10,598	1918	5,565,561	506,466
1908	54,000	3,544	1919	1,384,192	101,046
1909			1920	1,188,009	96,229
1910			1921	846,184	42,309
1911	2,679,842	152,751	1922	3,034,430	172,963
1912	4,331,391	298,866	1923		
1913	1,157,947	64,845	1924	3,060,000	198,900
1914	399,641	20,381	1925	11,546,602	877,542
1915	13,043,411	1,617,383			
1916	15,950,565	2,137,375	Totals	76,480,338	$7,522,954

Concentrating plant of California Zinc Company at Winthrop, Shasta County.
Photo by C. A. Logan.

CHAPTER FOUR.

STRUCTURAL MATERIALS.

Bibliography: State Mineralogist Reports XII–XXII (inc.). Bulletin 38. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

As indicated by this subdivision heading, the mineral substances herein considered are those more or less directly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the state. This branch of the mineral industry for 1925 was valued at $53,526,995 as compared with a total value of $51,310,197 for the year 1924, the increase being due mainly to cement and granite.

Deposits of granite, marble and other building stones are distributed widely throughout this state, and transportation and other facilities are gradually being extended so that the growing demand may be met. The largest single item, cement, has had an interesting record of growth since the inception of the industry in California about 1891. Not until 1904 did the annual value of cement produced reach the million-dollar mark, following which it increased 500% in nine years; though from 1914 to 1918 there was a falling off common to all building materials. The 1925 output establishes a new high-level mark, in quantity, but the total value was a little short of the record figure of 1923.

Crushed rock production is yearly becoming more worthy of consideration, due to the strides taken in the use of concrete, as well as to activity in the building of good roads. Brick, with an average annual output for a number of years worth approximately $2,000,000, had difficulty in holding its own, due to the popularity of cement and concrete. In 1920, however, the sales increased to nearly double the previous record figure of the year 1907, and in 1923 showed advances to new figures, with a slight recession in 1924 and 1925. This item will, no doubt, continue to be an improtant one, and a market for fire and fancy brick of all kinds will unquestionably never be lacking.

All fifty-eight counties contributed to this structural total for 1925. There is not a county in the state which is not capable of some output of at least one of the materials under this classification.

The following summary shows the value of the structural materials produced in California during the years 1924–1925, with increases or decreases in each instance:

Substance	1924		1925		Increase + Decrease— Value
	Amount	Value	Amount	Value	
Bituminous rock	6,040 tons	$14,922	*	*	* —
Brick and hollow building tile		9,137,908		$7,503,976	$1,633,932—
Cement	11,655,131 bbls.	23,225,850	13,206,630 bbls.	25,043,335	1,817,485+
Chromite	350 tons	6,700	591 tons	10,912	4,212+
Granite		1,211,046		1,853,859	642,813+
Lime	62,029 tons	703,355	61,922 tons	685,528	17,827—
Magnesite	67,236 tons	900,183	64,623 tons	872,944	27,239—
Marble	[a]61,579 cu. ft.	140,253	35,664 cu. ft.	116,105	24,148—
Onyx and travertine	[b]		19,940 cu. ft.	16,120	16,120+
Sandstone	6,700 cu. ft.	3,600	14,704 cu. ft.	14,362	10,762+
Stone, miscellaneous		15,966,380		17,409,854	1,443,474+
Total value		$51,310,197		$53,526,995	
Net increase					$2,216,798+

*Under 'Unapportioned.'

[a] Includes onyx and travertine.

[b] Combined with marble.

ASPHALT.

Bibliography: State Mineralogist Reports VII, X, XII–XV (inc.), XVII, XVIII. Bulletins 16, 32, 63, 67, 69, 91.

Asphalt was for a number of years accounted for in the statistical reports by the State Mining Bureau, because in the early days of the oil industry, considerable asphalt was produced from outcroppings of oil sand, and was a separate industry from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be in part a duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous sandstones, and is recorded under that designation.

BITUMINOUS ROCK.

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XXI, XXII.

Small amounts of bituminous rock are still occasionally used for road dressing in those districts adjacent to available deposits, though the manufacture of asphalt at the oil refineries has almost eliminated the direct use of the native material. As there was only a single operator in 1925, the figures are concealed under the 'Unapportioned' item.

This material is essentially an uncemented sandstone which is saturated with and held together by a natural asphaltic constituent probably the residue from the evaporation of a crude petroleum deposit.

Bituminous Rock Production of California, by Years.

The following tabulation shows the total amount and value of bituminous rock quarried and sold in California, from the records compiled by the State Mining Bureau, annually since 1887:

Year	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1908	30,718	$109,818
1888	50,000	257,000	1909	34,123	116,436
1889	40,000	170,000	1910	87,547	165,711
1890	40,000	170,000	1911	75,125	117,279
1891	39,962	154,164	1912	44,073	87,467
1892	24,000	72,000	1913	37,541	78,479
1893	32,000	192,036	1914	66,119	166,618
1894	31,214	115,193	1915	17,789	61,468
1895	38,921	121,586	1916	19,449	66,561
1896	49,456	122,500	1917	5,590	18,580
1897	45,470	128,173	1918	2,561	9,067
1898	46,836	137,575	1919	4,614	18,537
1899	40.321	116,097	1920	5.450	27,825
1900	25,306	71,495	1921	8,298	43,192
1901	24,052	66,354	1922	4.624	13,570
1902	33,490	43,411	1923	2,945	11,780
1903	21,944	53,106	1924	6,040	14,922
1904	45,280	175,680	1925	*	*
1905	24,753	60,436			
1906	16,077	45,204	Totals	1,181,810	$3,632,155
1907	24,122	72,835			

*Concealed under 'Unapportioned.'

BRICK and HOLLOW TILE.

Bibliography: State Mineralogist Reports VIII, X, XII–XV (inc.), XVII–XXII (inc.). Bulletin 38. Preliminary Report, No. 7. Cal. Jour. of Development, June, 1925, pp. 5–6.

Bricks of many varieties and in important quantities are annually produced in California, as might be expected in a state with such diversified and widespread mineral resources. The varieties include common, fire, pressed, glazed, enamel, fancy, vitrified, sand-lime, and others. Not only do the plants here supply practically all of our own requirements in these products, but considerable quantities are shipped to contiguous territory and certain products are shipped over a much wider radius. So far as possible, the different kinds have been segregated in the tabulation herewith accompanying.

We also include under this heading the various forms of hollow building 'tile' or blocks. The application of these tile to residence construction as well as to other structures is growing; though their total for 1925 shows a slight drop from the figure of 1924.

The aggregate value of all kinds of brick in 1925 shows a decrease of approximately 18% from that of 1924, due mainly to a drop in the sales of common brick in the Los Angeles district. The total of glazed, pressed, fancy, vitrified, paving, and sand-lime brick also showed a decrease; while fire-brick advanced.

The detailed figures of brick and hollow tile production for 1925 by counties are given in the following tabulation. 'Production' in this case means *sales* of product of California manufacture; and 'value' is *net price* at the works, f. o. b. cars, trucks or boats.

Brick and Hollow Tile Production for 1925, by Counties.

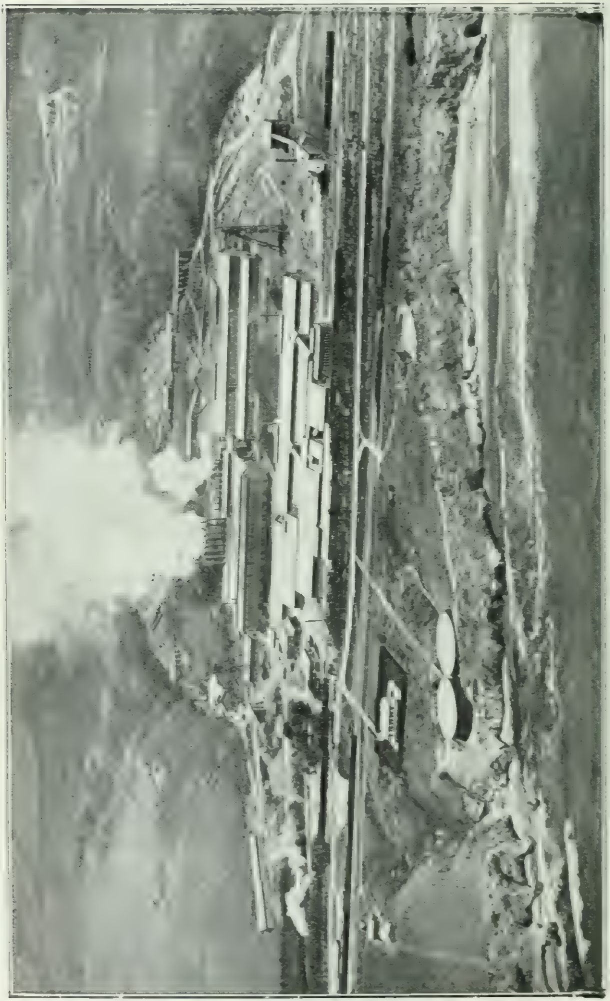
County	Common		Fire		Glazed, pressed, fancy, vitrified, paving		Hollow building tile or blocks		Total value
	Amount, M	Value	Amount, M	Value	Amount, M	Value	Tons	Value	
Alameda	*		3,105	$169,695	4,788	$213,057	*		$382,752
Fresno	6,048	$86,174	*		*		*		86,174
Kern	5,798	67,773							67,773
Los Angeles	170,771	1,754,639	a6,615	592,957	b19,569	953,152	44,845	$426,178	3,726,926
Orange	3,238	38,890			*				38,890
Sacramento	17,233	253,589	90	3,368	*		*		256,957
San Diego	7,981	93,165			*		*		93,165
San Joaquin	8,087	105,723	*				*		105,723
Santa Barbara	4,205	56,781					1,864	18,706	75,487
Santa Clara	24,250	251,059							251,059
Alameda, Amador, Butte, Contra Costa, Humboldt, Imperial, Marin, Mendocino, Merced, Riverside, San Luis Obispo, Tehama, Tulare*	49,838	609,973							609,973
Amador, Contra Costa, Fresno, Merced, Placerc, Riverside, San Joaquin*			18,391	884,486					884,486
Contra Costa, Fresno, Merced, Orange, Placer, Riverside, Sacramento, San Diego, San Luis Obispo*					11,087	347,905			347,905
Alameda, Contra Costa, Fresno, Merced, Placer, Riverside, Sacramento, San Diego, San Joaquin*							58,782	576,706	576,706
Totals	297,449	$3,317,766	28,201	$1,650,506	35,444	$1,514,114	105,491	$1,021,590	$7,503,976

*Combined to conceal output of a single operator in each.

[a] Includes special silica brick.

[b] Includes Ferguson sewer liners.

[c] Includes fire tile.



Plant of Santa Cruz Portland Cement Company, Davenport, Santa Cruz County. Airplane photo by courtesy of the company.

Brick and Hollow Tile Production of California, by Years.

Record of brick production in the state has been kept since 1893 by this Bureau, the figures for hollow building 'tile' or blocks being also included since 1914. The annual and total figures, for amount and value, are given in the following table:

Year	Brick, M	Hollow building blocks, tons	Value
1893	103.900	------------	$801,750
1894	81,675	------------	457,125
1895	131,772	------------	672,360
1896	24,000	------------	524,740
1897	97.468	------------	563,240
1898	100,102	------------	571,362
1899	125,950	------------	754,730
1900	137,191	------------	905,210
1901	130.766	------------	860,488
1902	169,851	------------	1,306,215
1903	214,403	------------	1.999.546
1904	281.750	------------	1.994.740
1905	286,618	------------	2.273.786
1906	277,762	------------	2,538,848
1907	362,167	------------	3.438,951
1908	332.872	------------	2.506.495
1909	333,846	------------	3.059.929
1910	340,883	------------	2.934.731
1911	327,474	------------	2.638.121
1912	337,233	------------	2.940.290
1913	358,754	------------	2.915.350
1914	270.791	------------	2.288.227
1915	180.538	------------	1,678,756
1916	206.960	------------	2.096,570
1917	192,269	29,348	2,532,721
1918	136,374	34.818	2.363.481
1919	156.328	36.026	3.087.067
1920	245,842	99,208	5,704,393
1921	238,022	67.100	5,570,875
1922	374,853	105.909	7,994.991
1923	397,754	122.534	9.738,082
1924	456.716	114.469	9,137,908
1925	361,094	105,491	7,503,976
Totals	7,773,978	714,903	$96,355,054

CEMENT.

Bibliography: State Mineralogist Reports VIII, IX, XII, XIV, XV, XVII, XVIII, XXI, XXII, Bulletin 38.

Cement is the most important single structural material in the mineral output of this state. During 1925, there was produced a total of 13,206,630 barrels, valued at $25,043,335 f. o. b. plant. This is an increase of 1,551,499 barrels over the record figure of 11,655,131 barrels in 1924, and an increase of $1,817,530 over the 1924 value of $23,225,850, but still a little short of the record value of $25,999,203 in 1923. The market in 1925 recovered to some extent from the effect of foreign importations duty-free, which caused the drop in 1924, but the effect had not wholly disappeared.

The 1925 output came from ten operating plants in eight counties, and employing a total of 3166 men. The three plants in San Bernardino County made a total of 5,079,281 barrels valued at $8,828,044, the balance of the state's product coming from a single plant in each of the following counties: Contra Costa, Kern, Riverside, San Benito, San Mateo, Santa Cruz, and Solano. The new plant of the Pacific Portland Cement Company at Redwood City, San Mateo County, began commercial production in 1925. For 1926, the plant of the Calaveras Cement Company has been completed near San Andreas, Calaveras County, and has joined the producing list.

Cement Production of California, by Years.

'Portland' cement was first commercially produced in California in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco.

[1] "The Benicia Cement Company in 1859-60 was turning out 50 to 100 barrels of cement a day and San Francisco was using about 12.000 barrels a year. The mill price of the product was then $4 a barrel. By 1865, the San Francisco rate of consumption had increased to 100,000 barrels yearly, brick buildings largely taking the place of frame structures, and the price of cement had fallen to $2.50 a barrel, about the same as it is today."

The growth of the industry became rapid after 1902; since which time cement has continued to be an important factor in the industrial life of the state. Although the total cement figures, to date, are not of the same magnitude as those for gold and petroleum, it is interesting to note that the value of California's cement yield beginning with 1920 has since annually exceeded the value of her gold output.

Annual production of cement in California has been as follows:

Year	Barrels	Value	Year	Barrels	Value
1891	5,000	$15,000	1910	5,453,193	$7,485,715
1892	5,000	15,000	1911	6,371,369	9,085,625
1893	-----------	-----------	1912	6,198,634	6,074,661
1894	8,000	21,600	1913	6,167,806	7,743,024
1895	16,383	32,556	1914	5,109,218	6,558,148
1896	9,500	28,250	1915	4,918,275	6,044,950
1897	18,000	66,000	1916	5,299,507	6,210,293
1898	50,000	150,000	1917	5,790,734	7,544,282
1899	60,000	180,000	1918	4,772,921	7,969,909
1900	52,000	121,000	1919	4,645,289	8,591,990
1901	71,800	159,842	1920	6,709,160	14,962,945
1902	171,000	423,600	1921	7,404,221	18,072,120
1903	640,868	968,727	1922	8,962,135	16,524,056
1904	969,538	1,539,807	1923	10,825,405	25,999,203
1905	1,265,553	1,791,916	1924	11,655,131	23,225,850
1906	1,286,000	1,941,250	1925	13,206,630	25,043,335
1907	1,613,563	2,585,577			
1908	1,629,615	2,359,692	Totals	125,140,653	$214,505,350
1909	3,779,205	4,969,437			

CHROMITE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV, XVII, XVIII, XXI, XXII. Bulletins 38, 76, 91. Preliminary Report 3. U. S. G. S., Bull. 430. Min. & Sci. Press, Vol. 114, p. 552.

Chromic iron ore, or chromite, to the amount of 191 short tons, recalculated to a basis of 45% Cr_2O_3, valued at $3,712 f.o.b. shipping point, was sold in California during the year 1925. This was largely of ore that had been mined during the World War period but not then sold. It is hoped that the development of the steel industry and the resumption of copper smelting on the Pacific Coast may create some demand for California's chromite, but the outlook for the immediate future is not encouraging.

---

[1] Monthly Review, of Mercantile Trust Co. of Cal., Vol. XIII, No. 3, p. 55, Mar. 1924.

With reference to the War Minerals Relief bills and their administration in which the chromite producers are particularly interested, under the Shortridge amendment of 1921 and under indirect or published stimulation as distinguished from direct personal demand, there has been paid to claimants principally in western states more than five million dollars; while under the act of March 2, 1919, which has been so construed as to limit recoveries to losses induced by direct personal demand, there has been paid about two million. Certain rejected losses now being litigated are principally in claims under the original act, though there are many claimants qualified under the Shortridge amendment who will be entitled to relief in the event the litigation is favorable to the claimants, or in the event further, pending legislation (Oddie's Senate Bill 3641) is enacted.

Occurrence.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came from California. From 1820 to 1860 the deposits in Pennsylvania and Maryland supplied the world's consumption.

Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno, and Tuolumne counties. In 1918 a total of 29 counties contributed to the state's output. There are two main belts in California yielding this mineral, one along the Coast Ranges from San Luis Obispo County to the Oregon line, including the Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which have been derived by alteration of such basic rocks. For the most part, so far as developments have yet shown, the lenses have proved to be small, relatively few of them yielding over 100 tons apiece. A notable exception to this was the deposit on Little Castle Creek, near Dunsmuir, from which upwards of 15,000 tons was shipped before it was exhausted. Deposits worked in Del Norte County during 1918 promise well for a large tonnage. On the whole the orebodies in the northwestern corner of the state appear to average larger in size than the chromite lenses in other parts of California.

Concentration became an accomplished fact in several localities, thus utilizing some of the disseminated and lower-grade orebodies which have been found. In fact, an important part of the 1918–1920 production came from that source.

Imports.

Importations of foreign chromite, duty free, mainly from Rhodesia, New Caledonia, and India, totaled 149,739 long tons in 1925, valued at $1,207,420, compared with 118,343 long tons and $1,095,603 in 1924,

Uses.

The major consumption of chromite ore is for use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferrochrome for chrome-steel alloys, and of chromium chemicals.

Total Chromite Production of California.

Production of chromite in California began, apparently, about 1874, principally in San Luis Obispo County. There was considerable activity from 1880 to 1883, inclusive, and a total of 23,238 long tons (or 26,028 short tons), valued at $329,924 was shipped from that county up to the beginning of 1887. Some ore also was shipped from the Tyson properties in Del Norte County. The tabulation herewith shows the output of chromite in California, annually, including the earliest figures so far as they are available. The figures from 1887 to date are from the records of the State Mining Bureau:

Year	Tons	Value
1874-1886 (San Luis Obispo Co.)	26,028	$329,924
1887	3,000	40,000
1888	1,500	20,000
1889	2,000	30,000
1890	3,599	53,985
1891	1,372	20,580
1892	1,500	22,500
1893	3,319	49,785
1894	3,680	39,980
1895	1,740	16,795
1896	786	7,775
1897		
1898		
1899		
1900	140	1,400
1901	130	1,950
1902	315	4,725
1903	150	2,250
1904	123	1,845
1905	40	600
1906	317	2,859
1907	302	$6,040
1908	350	6,195
1909	436	5,309
1910	749	9,707
1911	935	14,197
1912	1,270	11,260
1913	1,180	12,700
1914	1,517	9,434
1915	3,725	38,044
1916	48,943	717,244
1917	52,379	1,130,298
1918	73,955	3,649,497
1919	*4,314	97,164
1920	1,770	43,031
1921	347	6,870
1922	379	6,334
1923	84	1,658
1924	350	6,700
1925	191	3,712
Totals	242,915	$6,422,897

* Recalculated to 45% Cr_2O_3, beginning with 1919.

GRANITE.

Bibliography: State Mineralogist Reports, X, XII–XXI (inc.). Bulletin 38.

The value of the granite output of California for 1925 was the highest recorded for any year since the compilation of these figures by the State Mining Bureau, due mainly to the contract for the construction of the new Los Angeles County Building. Stone for 'monumental' and decorative purposes showed a decrease in both quantity and total value. The net result was an increase in total value of the several groups from $1,211,046 to $1,853,859. We have included under this heading some rhyolite and tuff utilized for dimension building stone, as we have no other dimension stone grouping for statistical purposes in this report except marble and sandstone.

Crushed rock, rubble, and paving blocks derived from granite quarries are given under the heading of 'Miscellaneous Stone.'

So far as possible, granite production has been segregated in the table herewith into the various uses to which the product was put. It will be noted, however, that a portion of the output has been entered under the heading 'Unclassified.' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same in the rough.

Varieties.

For building purposes, the granites found in California, particularly the varieties from Raymond in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at Raymond and Porterville, are unlimited. Most of California's 'granite,' particularly that found in the Sierra Nevada Mountains, is technically 'granodiorite' (that is, both plagioclase and orthoclase feldspars are present).

Granites of excellent quality for building and ornamental purposes are also quarried in Riverside and San Diego counties. Near Lakeside, San Diego County, there is a fine-grained, 'silver gray' granite of uniform texture and color, especially suited for monumental and ornamental work.

The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes. There is also a similar 'black granite' in Tulare County, near Success.

Granite Production by Counties, for 1925.

County	Building stone		Monumental		Curbing		Unclassified		Total value
	Cubic feet	Value	Cubic feet	Value	Linear feet	Value	Cubic feet	Value	
Fresno			15,097	$63,580					$63,580
Placer	*		3,513	6,426	*		*		6,426
Riverside	335	$300	6,000	28,502			1,150	$2,832	31,634
Sacramento	124,200	155,250							155,250
San Diego	50	125	28,456	108,578					108,703
Inyo^a, Madera, Placer, Sonoma^a, Tulare*	16,704	118,127							118,127
Madera, Nevada, Plumas, Tulare, Tuolumne*			5,004	24,302					24,302
Madera, Nevada, Placer*					3,181	$4,103			4,103
Madera, Placer, Tulare*							671,070	1,341,044	1,341,044
Totals	171,289	$274,402	58,670	$231,178	3,181	$4,103	675,220	$1,343,876	$1,853,850

* Combined to conceal output of a single operator in each.

a Tuff used for building stone.

Granite Production of California, by Years.

The value of granite produced, annually, since 1887, has been as follows:

Year	Value	Year	Value
1887	$150,000	1907	$373,376
1888	57,000	1908	512,923
1889	1,329,018	1909	376,834
1890	1,200,000	1910	417,898
1891	1,300,000	1911	355,742
1892	1,000,000	1912	362,975
1893	531,322	1913	981,277
1894	228,816	1914	628,786
1895	224,329	1915	227,928
1896	201,004	1916	535,339
1897	188,024	1917	221,997
1898	147,732	1918	139,861
1899	141,070	1919	220,743
1900	295,772	1920	495,732
1901	519,285	1921	725,901
1902	255,239	1922	676,643
1903	678,670	1923	760,081
1904	467,472	1924	1,211,046
1905	353,837	1925	1,853,859
1906	344,083	Total value	$20,691,614

LIME.

Bibliography: Reports XIV, XV, XVII, XVIII. Bulletin 38.

Lime to the amount of 61,922 tons, valued at $685,528, was produced by nine plants in seven counties during 1925, as compared with 62,922 tons valued at $703,355, in 1924. There were two plants each in San Bernardino and Santa Cruz counties, and one each in El Dorado, Kern, Siskiyou, Tulare, and Tuolumne.

So far as we have been able to segregate the data, these figures include mainly only such lime as is used in building operations; though they do include a small proportion of calcined lime employed in agriculture and the chemical industries, the figures for which were not separable. A portion is hydrated lime. Limestone utilized in sugar making, for smelter flux, as a fertilizer, and other special industrial uses, are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

Lime Production of California, by Years.

The following tabulation gives the amounts and value of lime produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. The figures for quantity have been recalculated from 'barrels' to 'tons' for the years 1894-1922 (inc.):

Year	Tons	Value	Year	Tons	Value
1894	37,350	$318,700	1911	42,959	$390,988
1895	39,776	386,094	1912	52,212	464,440
1896	30,275	261,505	1913	61,344	528,547
1897	28,780	252,900	1914	43,996	378,663
1898	29,786	254,010	1915	35,653	286,304
1899	29,985	314,575	1916	49,364	390,475
1900	31,252	283,699	1917	50,073	311,380
1901	31,738	334,688	1918	43,684	461,315
1902	44,866	369,616	1919	42,070	552,043
1903	49,659	418,280	1920	46,314	557,232
1904	57,945	571,749	1921	46,353	610,619
1905	61,700	555,322	1922	57,875	671,747
1906	68,927	763,060	1923	70,894	788,834
1907	68,422	756,376	1924	62,029	703,355
1908	39,639	379,243	1925	61,922	685,528
1909	52,075	577,824			
1910	47,951	477,683	Totals	1,516,868	$15,056,794

MAGNESITE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXII. Bulletins 38, 79. U. S. Geol. Surv., Bulletins 355, 540; Min. Res. 1913, Pt. II, pp. 450–453. Min. & Sci. Press, Vol. 114, p. 237. "Magnesite"—Hearings before the Comm. on Ways and Means, House of Repr., on H. R. 5218, June 16, 17, and July 17, 1919. Eng. Soc. W. Penn., Proc. 1913, Vol. 29, pp. 305–388, 418–444. Eng. & Min. Jour.-Press, Vol. 114, July 29, and Dec. 2, 1922. U. S. Tariff Comm., "Crude and Caustic Calcined Magnesite. A Preliminary Statement of Information," May 19, 1926.

The production of magnesite in California during 1925 amounted to a total of 64,623 tons of crude ore valued at $872,944. Only a small part of it was sold 'crude,' however, as it is practically all shipped in the calcined form. The reports at hand show a total of 28,110 tons shipped calcined, of which 3726 tons was dead-burned and sold for refractory purposes, the balance going to the plastic trade. From 2 to 2½ tons of crude material are mined to make one ton of calcined. The 1925 output is a slight decrease both in quantity and value from the 1924 figures of 67,236 tons crude valued at $900,193. The average of the values reported for 1925 is $13.50 per ton compared with $13.40 in 1924.

The more important producing properties in 1925 were: Maltby No. 1 (Western Magnesite Development Co., operated under lease by C. S. Maltby) on Red Mountain, Santa Clara County; and the Sierra Magnesite Company's group near Porterville, Tulare County; followed in order by the Sampson Peak Mine (Maltby No. 3), San Benito County and California Magnesia Company (old Harker Mine) at Porterville. A small amount was also contributed from Stanislaus County.

A preliminary press bulletin by Mr. J. M. Hill of the U. S. Bureau of Mines (Mar. 1, 1926) shows: Imports of magnesite in 1925 were 4429 tons crude, valued at $54,593, most of which came from Italy; 17,102 tons of caustic calcined, valued at $414,734, over half of which came from India, and 47,613 tons of dead-burned, valued at $703,074, practically all of which was from Italy. This was the equivalent of a total of 143,440 tons of crude ore.

Occurrence.

Magnesite is a natural carbonate of magnesium, and when pure contains 52.4% CO_2 (carbon dioxide) and 47.6% MgO (magnesia). It has a hardness of 3.5 to 4.5, and specific gravity of 3 to 3.12. It is both harder and heavier than calcite (calcium carbonate), and also contains a higher percentage of CO_2 as calcite has but 44%.

Most of the California magnesite is comparatively pure, and is ordinarily a beautiful, white, fine-grained rock with a conchoidal fracture resembling a break in porcelain. The Grecian magnesite is largely of this character; but the Austrian varieties usually contain iron, so that they become brown after calcining. The Washington magnesite resembles dolomite and some crystalline limestones in physical appearance. Its color varies through light to dark gray, and pink.

In California the known deposits are mostly in the metamorphic rocks of the Coast Ranges and Sierra Nevada Mountains, being associated with serpentine areas. The notable exceptions are the sedimentary deposits, at Bissell in Kern County and at Afton in San Bernardino County. Several thousand tons have been shipped from the Bissell deposit; and small shipments have been made from the Afton property.

The Washington deposits are associated with extensive strata of dolomitic limestone. The magnesite there appears to contain more iron than most of the California mineral, which makes it desirable for the steel operators. However, recent experience has proved that several California localities have sufficient iron in their magnesite to be serviceable in the steel furnaces. This is particularly true of the Refractory Magnesite Company's mine near Preston in Sonoma County, the White Rock Mine at Pope Valley and the Blanco Mine in Chiles Valley, Napa County. There is some also at the Sampson Peak property in San Benito County.

Uses.

The principal uses include: Refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters, bullion and other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for exterior stucco, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. In connection with building work it has proved particularly efficient as a flooring for steel railroad coaches, on account of having greater elasticity and resilience than 'Portland' cement. For refractory purposes the magnesite is 'dead-burned'—*i. e.*, all or practically all of the CO_2 is expelled from it. For cement purposes it is left 'caustic'—*i. e.*, from 2% to 10% of CO_2 is retained. When dry caustic magnesite is mixed with a solution of magnesium chloride ($MgCl_2$) in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours, as a tough, seamless surface. It has also a very strong bonding power, and will hold firmly to wood, metal, or concrete as a base. It may be finished with a very smooth, even surface, which will take a good wax or oil polish. As ordinarily mixed there is added a certain proportion of wood flour, cork, asbestos, or other filler, thereby adding to the elastic properties of the finished product. Its surface is described as 'warm' and 'quiet' as a result of the elastic and nonconducting character of the composite material. The cement is frequently colored by the addition of some mineral pigment to the materials before mixing as cement.

For refractory purposes the calcined magnesite is largely made up into bricks similar to fire-brick for furnace linings. It is also used unconsolidated, as 'grain' magnesite. For such, an iron content is desirable, as it allows of a slight sintering in forming the brick. Dead-burned, pure magnesia can not be sintered except at very high temperatures; and it has little or no plasticity, so that it is hard to handle. Its plasticity is said to be improved by using with it some partly calcined or caustic magnesite. Heavy pressure will bind the material sufficiently to allow it to be sintered.

A coating of crushed magnesite is laid on hearths used for heating steel stock for rolling, to prevent the scale formed from attacking the fire-brick of the hearth.

Before the World War, practically all of the domestic output of caustic magnesite was used in the manufacture of pulp and paper. For this purpose calcined dolomite is now used. The use of dolomite instead of magnesite by paper manufacturers began during the war when the price of magnesite was very high. Dolomite was found to be a good substitute for magnesite in the bisulphite process of paper making and so its use has continued.

The following table, based upon a study by the U. S. Tariff Commission,[1] shows the amounts and percentages of caustic magnesite used for various purposes during the first nine months of 1923.

"*Use*	*Short ton*	*Per cent of total*
"Stucco	34,420	73.6
Flooring	5,953	12.8
Rubber trade	577	1.2
Insulation	796	1.5
Chemicals	3,192	6.9
Not determined	1.865	4.0
	46.803	100.0

"Later information received from the magnesite trade indicates that a somewhat larger proportion of both domestic and foreign magnesite is being used for stucco and a smaller proportion for flooring. The exact amounts are not known.

* * * * * * *

"Transportation.

"All domestic caustic magnesite originates in California, but most of it is consumed east of the Mississippi and north of the Ohio. The largest producer ships his lump calcined product by rail to Joliet, Illinois, or by the Panama Canal to Jersey City, to be ground. The costs of shipment by all rail or via Panama are about the same for destinations midway between Harrisburg and Pittsburgh, Pennsylvania.

* * * * * * *

"Area of Competition.

"The market distribution of domestic and foreign caustic magnesite in this country for the months of September, October, and November, 1923, and the same months of 1924, was the subject of a special study by the Tariff Commission. The geographic center of consumption for the domestic product was found to be about midway along the Ohio-Michigan border, and was moving south. The corresponding center for the foreign product was near Harrisburg, Pa., and was moving west. The center for the combined domestic and foreign product was between Cleveland and Youngstown, Ohio, and was moving southwest.

---

[1] U. S. Tariff Comm.: Crude and Calcined Magnesite. A preliminary statement of Information, etc.: May 19, 1926, p. 4.

* * * * * * *

"In the territory comprising the states of New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, and Virginia the tonnage of imported magnesite sold was greater and the average price less than of the domestic magnesite. In the states of Michigan, Ohio, Indiana, Kentucky, Illinois, Wisconsin, and Missouri, the tonnage of imported magnesite sold was less and the average price greater than of the domestic magnesite.

"Delivered Costs and Prices.

"*Lump Magnesite.* Foreign lump magnesite, all of which comes from British India, is entered at the port of New York. Approximately 17 per cent of the domestic production of magnesite comes in lump form to New York (Jersey City), via the Panama Canal, all shipments to Jersey City being made by one California producer.

"The lump of both foreign and domestic origin is ground and later sold as ground magnesite.

"*Ground Magnesite.* Imported lump is ground in Brooklyn, while domestic lump is ground in Jersey City, in California, and in Joliet, Illinois.

* * * * * * *

"Lump magnesite, both imported and domestic, after grinding in Brooklyn and Jersey City, competes with that ground before importation, and, as it moves west, comes into competition with that ground at Joliet and in California. The available data would indicate that the eastern limit of competition is the North Atlantic seaboard, and that the western limit is approximately the Mississippi River. For these reasons the transportation and grinding costs have been summarized, as shown in Table 15, for magnesite laid down in the vicinity of New York City, in Chicago, and in Cleveland, the approximate center of consumption of the competitive territory.

"The price of imported magnesite at the foreign plant and the cost of production of domestic magnesite cannot be shown since confidential information would be revealed thereby.

"Table 15. Comparative costs, 1924, of placing domestic and imported magnesite at selected points in the competitive territory.

"Cost of grinding is assumed to be uniform for all magnesite, domestic and imported, ground in the United States.

(Per short ton.)

East (New York and Jersey City).

	Domestic		*Imported*	
Item	*Central California*	*Southern California*	*India*	*Netherlands*
Transportation and other charges of lump magnesite to grinding plant	[1] $13 29	------	[1] $10 07	------
Assumed average grinding cost in the United States	[2] 6 00	------	[2] 6 00	[3] ------
Transportation and other charges of ground magnesite	------	------	------	[4] $7 80
Totals	$19 29	------	$16 07	[5] $7 80
Middle West (Chicago and Cleveland).				
Transportation and other charges of lump magnesite to grinding plant	[6] $10 00	------	[1] $10 07	------
Assumed average grinding cost in the United States	6 00	$6 00	6 00	[3] ------
Subtotals	$16 00	$6 00	$16 07	------
Transportation of ground magnesite to Chicago	1 60	10 00	7 70	[7] $15 50
Totals at Chicago	$17 60	$16 00	$23 77	[5] $15 50
Transportation of ground magnesite to Cleveland	$4 10	$13 00	$5 10	[7] $12 90
Totals at Cleveland	$20 10	$19 00	$21 17	[5] $12 90

[1] Not including port charges at New York or Jersey City.

[2] Grinding done in metropolitan area of New York City.

[3] Grinding done in Netherlands; no cost data are available.

[4] Grinding plant in Netherlands, to New York; port charges at New York not included.

[5] Does not include cost of grinding in Netherlands.

[6] All rail to Joliet.

[7] Netherlands to Chicago or Cleveland; includes transportation, insurance, consul fees, and miscellaneous charges."

Imports and Domestic Production.

Reports of the U. S. Bureau of Foreign and Domestic Commerce show imports of calcined magnesite to have been 172,591 long tons in 1913; 144,747 in 1914, and 63,347 in 1915; most of it coming from

Austria-Hungary and some from Greece, that from the former being refractory dead-burned and from the latter caustic. For the same years the production of crude (from 2 to 2½ tons of crude ore required to yield one ton of the calcined) magnesite in California (the sole producer of those years, in the United States) was: 9632 short tons, 11,438 tons, 30,721 tons, respectively. For 1916 the California output leaped to 154,052 tons of crude and to 209,648 tons in 1917, but following which it dropped considerably on account of resumption of foreign importations, which totaled 52,483 long tons in 1921, valued at $776,384, being then admitted duty free. Shipments from Washington were begun late in 1916; and during the following three years assumed important proportions.

The Tariff Act of 1922, which became effective September 22d, of that year, placed the following import duties on magnesite: Crude magnesite $\frac{5}{16}$¢ per lb., caustic-calcined magnesite $\frac{5}{8}$¢ per lb.; dead-burned and grain magnesite, not suitable for manufacture into oxychloride cements, $\frac{23}{40}$¢ per lb.; magnesite brick, $\frac{3}{4}$¢ per lb. and 10% ad valorem. The figures of imports for 1925 as published by the U. S. Bureau of Foreign and Domestic Commerce, show a total of 69,117 short tons of calcined ore valued at $1,172,644, as compared with 70,406 tons and $1,098,998 in 1924.

Total Magnesite Production of California.

The first commercial production of magnesite in California was made in the latter part of 1886 from the Cedar Mountain district,[1] southeast of Livermore, Alameda County. Shipments amounting to 'several tons' or 'several carloads' were sent by rail to New York; but there is apparently no exact record of the amount for that first year. The statistical records of the State Mining Bureau began with the year 1887, and the table herewith shows the figures for amount and value, annually, from that time. Shipments of magnesite from Napa County began in 1891 from the Snowflake Mine; from the Red Mountain deposits in Santa Clara County, in 1899; and from Tulare County in 1900.

Production of Magnesite in California, Since 1887.

Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1907	6,405	$57,720
1888	600	9,000	1908	10,582	80,822
1889	600	9,000	1909	7,942	62,588
1890	600	9,000	1910	16,570	113,887
1891	1,500	15,000	1911	8,858	67,430
1892	1,500	15,000	1912	10.512	105,120
1893	1,093	10,930	1913	9,632	77,056
1894	1,440	10,240	1914	11.438	114,380
1895	2,200	17,000	1915	30,721	283,461
1896	1,500	11,000	1916	154.052	1.311.893
1897	1,143	13,671	1917	209.648	1,976,227
1898	1,263	19,075	1918	83,974	803,492
1899	1,280	18,480	1919	44.696	452.094
1900	2,252	19,333	1920	83,695	1,033,491
1901	4,726	43,057	1921	47,837	511,102
1902	2,830	20.655	1922	55.637	594.665
1903	1,361	20.515	1923	73,963	946.643
1904	2,850	9,298	1924	67,236	900,183
1905	3,933	16,221	1925	64,623	872,944
1906	4,032	40,320	Totals	1,035,324	$10,700,993

---

[1] See U. S. Geol. Surv.; Mineral Resources of U. S., 1886, pp. 6 and 696.

MARBLE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXI (inc.). Bulletin 38. U. S. Bur. of Mines, Bull. 106.

Marble is widely distributed in California, and in a considerable variety of colors and grain. The 1925 figures show a slight decrease both in quantity and value from those of 1924, being 35,664 cu. ft., worth $116,105.

California has many beautiful and serviceable varieties of marble, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onyx marble of beautiful coloring and effects. There is also serpentine marble suitable for electrical switchboard use.

Marble Production of California, by Years.

Data on annual production since 1887, as compiled by the State Mining Bureau, follows. Previous to 1894 no records of amounts were preserved.

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$5,000	1907	37,512	$118,066
1888		5,000	1908	18,653	47,665
1889		87,030	1909	79,600	238,400
1890		80,000	1910	18,960	50,200
1891		100,000	1911	20,201	54,103
1892		115,000	1912	27,820	74,120
1893		40,000	1913	41,654	113,282
1894	38,441	98,326	1914	25,436	48,832
1895	14,864	56,566	1915	22,186	41,518
1896	7,889	32,415	1916	25,954	50,280
1897	4,102	7,280	1917	24,755	62,950
1898	8,050	23,594	1918	[a]17,428	49,898
1899	9,682	10,550	1919	25,020	74,482
1900	4,103	5,891	1920	[b]29,531	92,899
1901	2,945	4,630	1921	30,232	98,395
1902	19,305	37,616	1922	38,321	127,792
1903	84,624	97,354	1923	28,015	124,919
1904	55,401	94,208	1924	[b]61,579	140,253
1905	73,303	129,450	1925	35,664	116,105
1906	31,400	75,800			
			Total value		$2,829,869

[a] Includes onyx and serpentine.
[b] Includes onyx.

ONYX and TRAVERTINE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII, XVIII. Bulletin 38.

Onyx and travertine are known to exist in a number of places in California, but there has been only a small and irregular production since the year 1896. In 1925 there were shipments from Solano and Mono counties totaling 19,940 cu. ft., valued at $16,120. The Solano County material was mainly used for terrazzo.

Onyx Production of California, by Years.

Production by years has been as follows:

Year	Value	Year	Value
1887	$900	1896	$24,000
1888	900	1918	*
1889	900	1919	
1890	1,500	1920	*
1891	2,400	1921	1,294
1892	1,800	1922	3,320
1893	27,000	1923	2,510
1894	20,000	1924	*
1895	12,000	1925	16.12
		Total value	$114,644

*See under Marble.

SANDSTONE.

Bibliography: State Mineralogist Reports XII–XV, XVII, XVIII, XXI. Bulletin 38. U. S. Bur. of M., Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of a lighter-colored building stone, has curtailed production in this branch of the mineral industry during recent years almost to the vanishing point. In 1925 a total of 14,704 cu. ft. valued at $14,362 was quarried in four counties, Colusa, Los Angeles, Monterey, and Siskiyou; compared with 6,700 cu. ft. and $3,600 in 1924. The material reported from Monterey County is in reality an indurated shale of the Monterey series, of a cream-color and utilized as a building stone.

Sandstone Production of California, by Years.

Amount and value, so far as contained in the records of this Bureau, are presented herewith, with total value from 1887 to date:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$175,000	1907	159,573	$148,148
1888		150,000	1908	93,301	55,151
1889		175,598	1909	79,240	37,032
1890		100,000	1910	165,971	80,443
1891		100,000	1911	255,313	127,314
1892		50,000	1912	66,487	22,574
1893		26,314	1913	62,227	27,870
1894		113,592	1914	111,691	45,322
1895		35,373	1915	63,350	8,438
1896		28,379	1916	17,270	10,271
1897		24,086	1917	31,090	7,074
1898		46,384	1918	900	400
1899	56,264	103,384	1919	5,400	3,720
1900	378,468	254,140	1920	10,500	2,300
1901	266,741	192,132	1921	10,150	2,112
1902	212,123	142,506	1922	900	1,100
1903	353,002	585,309	1923	7,000	13,000
1904	363,487	567,181	1924	6,700	3,600
1905	302,813	483,268	1925	14,704	14,362
1906	182,076	164,068	Total value		$4,126,945

SERPENTINE.

Bibliography: State Mineralogist Report XV. Bulletin 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917 and 1918, being the only output recorded since 1907. It was used for decorative building purposes and for electrical switchboards. As there was but a single operator, the figures were combined with those of marble output for those years.

Serpentine Production of California, by Years.

The following table shows the amount and value of serpentine from 1895 as recorded by this Bureau:

Year	Cubic feet	Value	Year	Cubic feet	Value
1895	4,000	$4,000	1904	200	$2,310
1896	1,500	6,000	1905		
1897	2,500	2,500	1906	847	1,694
1898	750	3,000	1907	1,000	3,000
1899	500	2,000	1917	[a]	[a]
1900	350	2,000	1918	[b]	[b]
1901	89	890	1919		
1902	512	5,065			
1903	99	800	Totals	12,347	$33,259

[a] Under 'Unapportioned.'
[b] See under Marble.

SLATE.

Bibliography: State Mineralogist Reports XV, XVIII. Bulletin 38. U. S. Geol. Surv., Bull. 586. U. S. Bur. of Mines, Bull. 218.

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, but since then it has been irregular. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

'Slate' is a term applied to a fine-grained rock that has a more or less perfect cleavage, permitting it to be readily split into thin, smooth sheets. Varieties differ widely in color and have a considerable range in chemical and mineralogical composition. Excepting certain rare slates of igneous origin (of which the green slate of the Eureka quarry, El Dorado County, California, is an example) formed from volcanic ash or igneous dikes, slates have originated from sedimentary deposits consisting largely of clay. By consolidation, and the pressure of superimposed materials, clays become bedded deposits of shale. By further consolidation under intense pressure and high temperature incident to mountain-building forces, shales are metamorphosed to slates. The principal mineral constituents are mica, quartz, and chlorite, with smaller varying amounts of hematite, rutile, kaolin, graphite, feldspar, tourmaline, calcite, and others.

The color of slate is of economic importance. The common colors are gray, bluish gray, and black, though reds and various shades of green are occasionally found.

The permanency of slate for roofing is well known. It is stated that there are slate roofs in Pennsylvania and Maryland over 100 years old.

> [1] "In England and Wales, and in France, many buildings constructed in the 15th and 16th centuries were roofed with slate, and the roofs are still in excellent condition. There is a record of a chapel in Bedford-on-Avon in Wiltshire, England, roofed with slate in the 8th century, and after 1200 years of climatic exposure is moss-covered but in good condition."

Contrary to the general impression, however, the major portion of the slate produced in the United States is used on the inside rather than the outside of buildings. Its interior uses include stationary washtubs, electrical switchboards, and blackboards.

El Dorado County slate placed on roof of a residence being built in Oakland, California, September, 1926.

A square of roofing slate is a sufficient number of pieces of any size to cover 100 square feet of roof, with allowance generally for a three-inch lap. The sizes of the pieces of slate making up a square range from 7 x 9 inches to 16 x 24 inches, and the number of pieces in a square ranges from 85 to 686. The Ferry Building, San Francisco, is roofed with Eureka slate from El Dorado County.

In California, there were no shipments in 1925, but at present there are prospects of commercial output being renewed; in fact, some small shipments have already been made for the current year.

---

[1] Bowles, O., Slate as a permanent roofing material: U. S. Bur. of M., Reports of Investigations, Serial No. 2267, July, 1921, p. 4.

Total Production of Slate in California.

A complete record of amount and value of slate produced in California follows:

Year	Squares	Value	Year	Squares	Value
1889	4,500	$18,089	1904	6,000	$50,000
1890	4,000	24,000	1905	4,000	40,000
1891	4,000	24,000	1906	10,000	100,000
1892	3,500	21,000	1907	7,000	60,000
1893	3,000	21,000	1908	6,000	60,000
1894	1,800	11,700	1909	6,961	45,660
1895	1,350	9,450	1910	1,000	8,000
1896	500	2,500	1911	--------	--------
1897	400	2,800	1915	1,000	5,000
1898	400	2,800	1916	--------	--------
1899	810	5,900	1920	8	80
1900	3,500	26,250	1921	--------	--------
1901	5,100	38,250	1922	*	*
1902	4,000	30,000	1923	--------	--------
1903	10,000	70,000			
			Totals	88,829	$676,479

*Concealed under 'Unapportioned.'

MISCELLANEOUS STONE.

Bibliography: State Mineralogist Reports XII–XXII (inc.). Bulletin 38; also annual statistical bulletins from 1915 to date.

'Miscellaneous stone' is the name used throughout this report as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills. The foregoing are very closely related from the standpoint of the producer; therefore it has been found to be most satisfactory to group these items as has been done in recent reports of this Bureau. So far as it has been possible to do so, crushed rock production has been subdivided into the various uses to which the product was put. It will be noted, however, a very large percentage of the output has been tabulated under the heading 'Unclassified.' This is necessary because of the fact that many of the producers have no way of telling to what specific use their rock was put after they have quarried and sold the same to distributors and contractors.

In addition to amounts produced by commercial firms, both corporations and individuals, there is hardly a county in the state but uses more or less gravel and broken rock on its roads. Of much of this, particularly in the country districts, there is no definite record kept.

For the year 1925, crushed rock registered gains both in tonnage and value over the preceding year; as did also sand and gravel. The result was a total value of $17,409,854 as compared with $15,966,380 in 1924. Continuance of general building work and highway paving are in part responsible as well as hydro-electric power-plant installations and harbor protection (breakwater and jetty construction).

As for some years past, Los Angeles County led all others by a wide margin with an output valued at $6,978,605 (compared with $5,923,329); followed by Alameda, second, with $1,414,398; Contra Costa, third, $708,159; Humboldt, fourth, $699,740; Sacramento, fifth, $590,359; Riverside, sixth, $542,020; San Diego, seventh, $508,538; Fresno, eighth, $457,307; followed in turn by Santa Clara, Mariposa, San Bernardino, San Benito, Shasta, Orange, and Del Norte, in the order named, each with a total between a half- and a quarter-million dollars value.

Paving Blocks.

The paving block industry has decreased materially of recent years, almost to the vanishing point, because of the increased construction of smoother pavements demanded by motor-vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma are of basalt, andesite, and some trachyte, while those from Placer, Riverside, San Bernardino, and San Diego are of granite.

Production in 1925 amounted to 27 M, valued at $1,350.

The amount and value of paving block production annually since 1887 has been as follows:

Year	Amount M	Value	Year	Amount M	Value
1887	*10,000	$350,000	1907	4,604	$199,347
1888	10,500	367,500	1908	7,660	334,780
1889	7,303	297,236	1909	4,503	199,803
1890	7,000	245,000	1910	4,434	198,916
1891	5,000	150,000	1911	4,141	210,819
1892	*3,000	96,000	1912	11,018	578,355
1893	2,770	96,950	1913	6,364	363,505
1894	2,517	66,981	1914	6,053	270,598
1895	2,332	73,338	1915	3,285	171,092
1896	4,161	77,584	1916	1,322	54,362
1897	1,711	35,235	1917	938	38,567
1898	1,144	21,725	1918	372	17,000
1899	305	7,861	1919	27	1,350
1900	1,192	23,775	1920	63	3,155
1901	1,920	41,075	1921	4	280
1902	3,502	112,437	1922	72	3,924
1903	4,854	134,642	1923	15	880
1904	3,977	161,752	1924	11	935
1905	3,408	134,347	1925	27	1,350
1906	4,203	173,432	Totals	135,702	$5,315,888

* Figures for 1887-1892 (inc.) are for Sonoma County only, as none are available for other counties during that period; though Solano County quarries were then also quite active.

Grinding Mill Pebbles.

Production of pebbles for tube and grinding mills began commercially in California in 1915. Owing to the decreased imports and higher prices of Belgium and other European flint pebbles, due to the war, there was a serious inquiry for domestic sources of supply. One of the shipments made in that year was of pebbles selected from gold-dredger tailings in Sacramento County, for use in a gold mill in Amador County employing Hardinge mills.

The important development in this item, however, took place in San Diego County. At several points along the ocean shore from Encinitas south to near San Diego, there are beaches of washed pebbles varying from 1 inch to 6 inches in diameter, which come from conglomerate beds made up of well-rounded water-worn pebbles of various granitic and porphyritic rocks with some felsite and flint. The wave action has broken down portions of the cliffs for considerable distances and formed beaches of the pebbles which are well washed and cleaned of the softer materials. The rocks sorted out for shipment are mainly basalt and diabase, with an occasional felsite and flint pebble. There is a tough black basalt which is stated to give satisfactory results. In Fresno County pebbles have been selected from the gravel beds of the San Joaquin River near Friant. Shipments have been made to metallurgical plants in California, Nevada, Montana and Utah.

Imports in 1925 amounted to 14.500 long tons, valued at $105,041 compared with 15.601 long tons and $114.958 in 1924.

Californian output for 1925 was 215 tons, valued at $1,385, a decrease from the 1924 figures.

The amount and value of grinding mill pebbles, annually, follows:

Year	Tons	Value
1915	340	$2,810
1916	20,232	107,567
1917	21.450	90.538
1918	8,628	61.268
1919	2.607	19.272
1920	2,104	17,988
1921	247	1.418
1922	1.571	7,628
1923	2,650	14,936
1924	434	2.969
1925	215	1,385
Totals	60,478	$257,779

Sand and Gravel.

A considerable part of the gravel excavated is passed through grading and washing plants, and the material over 2 inches in size is crushed. Much of it is utilized in concrete mixtures. Most of the gravel used for road surfacing and repairs as well as that for railroad ballast is creek-run or pit-run material which is spread upon the roads without undergoing any grading or washing.

Plant of Granite Rock Company at Logan, San Benito County. The quarry face shows above and to the left of the buildings. Photo by C. McK. Laizure.

The distribution of the 1925 output of sand and gravel, by counties, is given in the following table:

County	*Tons*	*Value*
Alameda	[a] 1,642,874	$1,024,891
Amador	18,850	21,200
Butte	86,727	57.592
Calaveras	1,719	1,305
Contra Costa	[a] 106,245	43,470
Del Norte	1.000	750
El Dorado	7.153	10.220
Fresno	577.071	249,527
Glenn	248.600	91,926
Humboldt	164.875	98,169
Imperial	166,940	138,294
Kern	6,000	3.000
Lake	25.500	15,300
Lassen	1,000	750
Los Angeles	[b] 4,591,655	2.869,229
Mariposa	817,735	328,794
Merced	67.333	27,300
Modoc	8,200	2,000
Mono	[c] 15,000	29,250
Monterey	[d] 264,927	209,423
Napa	35,029	25,015
Nevada	3.750	3,000
Orange	[e] 343.487	235.112
Placer	451.160	48,707
Riverside	[a] 13.270	13.542
Sacramento	[a f] 392.742	228.552
San Benito	69.066	73,175
San Bernardino	427,791	206.251
San Diego	[a] 539.210	384.965
San Francisco	[a] 18.500	16.250
San Joaquin	569.579	102,737
San Mateo	46.090	29,798
Santa Barbara	80.994	57,243
Santa Clara	406.280	345,049
Santa Cruz	[a] 18.666	14,625
Shasta	82.517	59,829
Sierra	5,200	3.050
Siskiyou	10.960	8.200
Solano	15.000	12.000
Sonoma	160.153	63.543
Stanislaus	224.426	172.256
Tehama	6.000	4,000
Tulare	25.235	12,735
Tuolumne	6.600	2.500
Ventura	[a] 132.133	105.800
Yolo	38.430	23.060
Yuba	[a] 222,558	137.288
Colusa, Madera, Marin, Mendocino, Plumas*	151.678	111.575
Totals	13,315,908	$7,722.247

* Combined to conceal output of a single operator in each.

[a] Includes molding sand.

[b] Includes plaster and brick sand.

[c] Crushed volcanic cinders.

[d] Includes molding, blast, filter, stucco, plaster, and roofing sand.

[e] Includes plaster sand and roofing gravel.

[f] Includes roofing gravel.

Included in the above is a total of 45.964 tons of molding sand, valued at $76.974 f.o.b. pit, from two operators in Alameda County, and one each in Contra Costa, Monterey, Riverside, Sacramento, San Diego, San Francisco, Santa Cruz, Ventura, and Yuba. This item is each year assuming a more important position in the commercial mineral list of California. The 1924 figures totaled 32.968 tons and $68,105.

Crushed Rock.

To list the kinds and varieties of rock utilized commercially under this heading would be to run almost the entire gamut of the classification scale. Much depends on the kind available in a given district. Those which give the most satisfactory service are the basalts and other hard, dense, igneous rocks which break with sharp, clean edges. In many localities, river-wash boulders form an important source of such material. In such cases, combined crushing and washing plants obtain varying amounts of sand and gravel along with the crushed sizes. In Sacramento and Butte counties the tailings piles from the gold dredgers are the basis of like operations.

The values given are based on the selling prices, f.o.b. cars, barges, or trucks, at the quarry.

Crushed Rock Production, by Counties, for 1926.

County	Macadam and ballast		Rubble and riprap		Concrete		Unclassified		Totals	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	112,875	$81,484	150	$720	172,877	$290,419	[a]15,214	$16,884	301,116	$389,507
Alpine	500	300							500	300
Butte	5,333	4,000					[b,c]90,431	95,116	95,764	99,116
Contra Costa	132,427	117,805	5,396	2,787	275,741	285,700	359,002	258,397	772,566	664,689
Del Norte	1,700	2,900	150,000	266,000					151,700	268,900
Humboldt	20,955	32,448	147,015	548,819			15,248	20,304	183,218	601,571
Lassen	500	500							500	500
Los Angeles	1,370,705	1,124,914	147,480	294,816	2,442,391	1,815,794	[b,d]1,232,077	864,852	5,192,053	4,100,376
Marin			9,185	11,940			236,680	228,064	245,865	240,004
Mariposa	26,500	79,500			9,333	11,000	[b,c]3,600	14,500	39,433	108,000
Mendocino	20,415	8,603							20,415	8,603
Napa	15,200	12,870			125,267	125,400	11,584	13,901	152,051	152,171
Nevada	6,273	7,333							6,273	7,333
Placer	22,248	33,581	3,000	3,900	27,654	31,802			52,902	69,283
Riverside			153,416	200,278	438,586	325,000	[f]140	1,900	592,142	527,178
Sacramento	52,160	36,080	2,470	1,363	1,496	1,964	403,000	322,400	459,135	361,807
San Bernardino	5,000	12,600	109,464	131,539	26,666	25,000	11,877	19,658	153,007	188,797
San Diego	15,985	7,500	9,403	11,331	87,433	99,557	12,944	3,750	125,765	122,138
San Francisco	30,353	38,499			59,140	76,409			89,493	114,908
San Luis Obispo	59,820	50,113							59,820	50,113
San Mateo	25,969	36,324			16,217	23,510	667	1,125	42,853	60,959
Santa Barbara	10,000	7,500					34,533	41,622	44,533	49,122
Santa Clara	1,200	1,500					139,656	106,721	140,856	108,221
Shasta	56,124	66,012			136,636	170,112	43,104	53,664	235,864	289,788
Sierra	173	377			500	250			673	627
Siskiyou	10,700	15,600							10,700	15,600
Sonoma	33,587	25,475	200	195	20,444	30,333			54,231	56,003
Tehama	20,240	63,083			3,320	5,000			23,560	68,083
Trinity					200	2,000	2,000	3,000	2,200	5,000
Tuolumne	6,333	3,688			[h]450	788	[b,g]3,591	22,761	10,374	27,237
Ventura					21,528	16,146	10,405	9,074	31,933	25,220
Amador, Calaveras, El Dorado, Merced, San Benito, Solano, Stanislaus, Sutter, Tulare*	448,991	322,498							448,991	322,498
Imperial and Madera*			60,580	13,498					60,580	13,498
Fresno, Glenn, Orange, San Benito, San Joaquin, Santa Cruz, Tulare*					310,669	228,705			310,669	228,705
Amador*, Calaveras*, Fresno, Solano*							381,816	327,884	381,816	327,884
Totals	2,518,275	$2,193,987	800,837	$1,187,186	1,476,548	$3,576,889	3,007,560	$2,426,810	10,503,220	$9,384,872

*Combined to conceal output of a single operator in each.

[a] Includes red roofing granules.

[b] Includes granules for roofing and stucco dash.

[c] Includes greenstone roofing granules.

[d] Includes granite grit for poultry.

[e] Includes jasper roofing granules.

[f] Includes black granite for stucco granules.

[g] Includes dolomitic marble for terazzo.

[h] Includes limestone dust for concrete filler.

[i] Includes mariposite for stucco dash granules.

Miscellaneous Stone Production of California, by Years.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that for concrete), and sand and gravel, since 1893, follow:

Crushed Rock, Sand and Gravel, by Years.

Year	Tons	Value	Year	Tons	Value
1893	371,100	$456,075	1910	5,827,828	$2,777,690
1894	661,900	664,838	1911	6,487,223	3,610,357
1895	1,254,688	1,095,939	1912	8,044,937	4,532,598
1896	960,619	839,884	1913	9,817,616	4,823,056
1897	821,123	600,112	1914	9.288,397	3,960,973
1898	1,177,365	814,477	1915	10,879,497	4,609,278
1899	964,898	786,892	1916	9,951,089	4,009.590
1900	789,287	561,642	1917	8,069,271	3,505,662
1901	530,396	641,037	1918	6,641,144	3,325,889
1902	2,056,015	1,249,529	1919	6,919,188	3.678,322
1903	2,215,625	1,673,591	1920	9,792,122	6,782,414
1904	2,296,898	1,641,877	1921	10,914,145	7,834,640
1905	2,624,257	1,716,770	1922	13,049.644	10,366,231
1906	1,555,372	1,418,406	1923	19,840,301	15.379.838
1907	2,288,888	1,915,015	1924	21,451,129	15,962,476
1908	3,998.945	3,241,774	1925	23,819,137	17,407,113
1909	5,531,561	2,708,326	Totals	210,891,605	134,592,311

A comparison of the above table of annual production of these materials with the similar table for cement (see *ante*), reveals the fact that the important growth of the crushed rock and gravel business has been coincident with the rapid development of the cement industry from the year 1902.

CHAPTER FIVE.

INDUSTRIAL MATERIALS.

Bibliography: State Mineralogist Reports XII–XXII (inc.). Bulletin 38. Min. & Sci. Press, Vol. 114, March 10, 1917. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

The following mineral substances have been arbitrarily arranged under the general heading of 'Industrial Materials,' as distinguished from those which have a clearly-defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are, with four or five exceptions, as yet produced on a comparatively small scale. The possibilities of development along several of these lines are large, and with increasing transportation and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is promising. There is scarcely a county in the state but might contribute to the output.

Up to within the last few years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely-varying amounts of a certain material produced from year to year, but in widely-varying prices of the same material.

The more important of these minerals thus far exploited, so far as shown by value of the output, are limestone, mineral water, pyrites, pottery clays, diatomaceous earth, gypsum, talc, and dolomite.

This group as a whole showed a slight increase in the total value to $5,379,064 in 1925 from $5,112,812 for 1924.

The following table gives the comparative figures for the amounts and values of industrial minerals produced in California during the years 1924 and 1925:

Substance	1924		1925		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Asbestos	70 tons	$4,750	*	*	*
Clay (pottery)	417,928 tons	651,857	537,587 tons	$674,376	$22,519—
Dolomite	28,843 tons	71,271	42,852 tons	104,900	33,629—
Feldspar	9,055 tons	68,112	8,165 tons	59,615	8,497—
Fuller's earth	5,290 tons	67,295	5,280 tons	91,842	24,547—
Gems		4,800		10,663	5,863—
Gypsum	25,569 tons	53,210	107,613 tons	172,444	119,234—
Limestone	219,476 tons	582,660	319,977 tons	494,525	88,135—
Lithia	109 tons	2,269			2,269—
Mineral paint	532 tons	5,234	669 tons	6,969	1,735—
Mineral water	8,159,211 gals.	818,726	12,115,072 gals.	1,230,455	411,729—
Pumice and volcanic ash	4,919 tons	33,404	5,319 tons	32,937	467—
Pyrites	124,214 tons	517,835	129,500 tons	528,550	10,715—
Silica (sand and quartz)	6,808 tons	35,006	12,498 tons	96,780	61,774+
Talc and soapstone	16,179 tons	242,770	15,465 tons	239,084	3,686—
Unapportioned		[a]1,953,613		[b]1,635,924	317,689—
Total value		$5,112,812		$5,379,064	
Net increase					$266,252—

*Under 'unapportioned.'

[a] Includes diatomaceous earth, shale oil, sillimanite-andalusite, sulphur, mica schist, radio galena crystals.

[b] Includes asbestos, diatomaceous earth, graphite, shale oil, sillimanite-andalusite.

ASBESTOS.

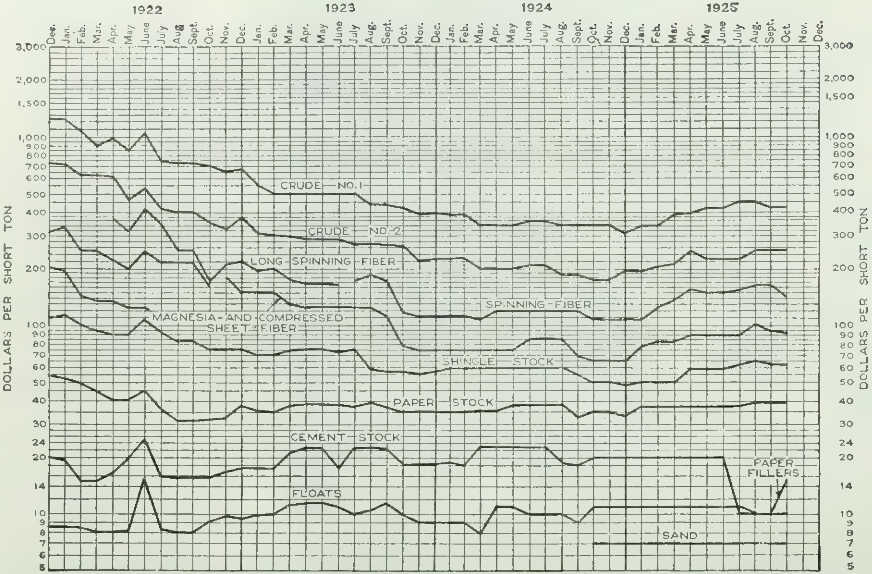
Bibliography: State Mineralogist Reports XII-XIX (inc.), XXII. Bulletins 38, 91. Canadian Dept. of M., Mines Branch Bulletin 69. Min. & Sci. Press, April 10, 1920, pp. 531-533. Eng. & Min. Jour.-Press, Vol. 113, pp. 617-625, 670-677.

In 1925 there was a small tonnage of crude asbestos ore and fibre produced in California, but as there was only a single operator, the figures are concealed under the 'Unapportioned' item.

The future of asbestos mining in California is dependent largely upon the development of uses in quantity for the short-fibre mill grades, and for the amphibole variety. There are apparently large resources of such material that can be made available. Some spinning-grade fibre has also been found in this state, notably in Nevada, Calaveras, and Monterey counties, but the commercial yield to date has been small. There are extensive serpentine areas in the Coast Ranges, in the Klamath Mountains, and in several sections of the Sierra Nevada Mountains which are within the range of possible asbestos producers, as chrysotile is a fibrous form of serpentine. These localities all yielded chromite in greater or less amounts during the World War period.

Asbestos fiberizing mill of the San Benito Asbestos Company, San Benito County. Photo by C. McK. Laizure.

Three-quarters of the world's supply of asbestos is produced by Canada. The accompanying chart shows the range of prices at Quebec, 1922-1925 (inc.).



Prices of Canadian asbestos, "crude" and "fiber," f.o.b., Quebec, 1922–1925. From U. S. Bureau of Mines.

Asbestos Production of California, by Years.

Total amount and value of asbestos production in California since 1887, as given in the records of this Bureau, are as follows:

Year	Tons	Value
1887	30	$1,800
1888	30	1,800
1889	30	1,800
1890	71	4,260
1891	66	3,960
1892	30	1,830
1893	50	2,500
1894	50	2,250
1895	25	1,000
1896		
1897		
1898	10	200
1899	30	750
1900	50	1,250
1901	110	4,400
1902		
1903		
1904	10	162
1905	112	2,625
1906	70	3,500
1907	70	$3,500
1908	70	6,100
1909	65	6,500
1910	200	20,000
1911	125	500
1912	90	2,700
1913	47	1,175
1914	51	1,530
1915	143	2,860
1916	145	2,380
1917	136	10,225
1918	229	9,903
1919 1920 *	131	6,240
1921	410	19,275
1922	50	1,800
1923	20	200
1924	70	4,750
1925	*	*
Totals	2,826	$133,725

*Annual details concealed under 'Unapportioned.'

BARYTES.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XXI. Bulletin 38. Eng. & Min. Jour.-Press, Vol. 114, p. 109, July 15, 1922; Vol. 115, pp. 319-324, Feb. 17, 1923.

There were no commercial shipments of crude barytes in California during 1924-1925. In 1923, the output amounted to a total of 2925 tons valued at $16,058 f. o. b. rail-shipping point. The 1923 product came mainly from Nevada County, with smaller amounts from Mariposa and Shasta counties, and was consumed principally in the manufacture of lithopone. More than half of the total tonnage of barytes utilized in the United States is taken in the manufacture of lithopone, which is a chemically-prepared, white pigment containing approximately 70% barium sulphate and 30% zinc sulphide. This is one of the principal constituents of 'flat' wall paints.

The principal uses for barytes, after washing and grinding, are as an inert pigment and filler in paint, paper, linoleum, oilcloth and rubber manufacture, and in the preparation of lithopone and a number of chemicals. The most important of such chemicals, other than lithopone, are: barium binoxide (used in preparation of hydrogen peroxide); barium carbonate (used by pressed brick and by rubber manufacturers to neutralize sulphur content); barium chloride (used in battery plates, and as a mordant by dry-color manufacturers, and in tanning leather); barium nitrate (used in munitions and in making 'red fire' material); barium sulphate precipitated, or 'blanc fixe' (used in rubber manufacture; for painting on interior steel of battleships and other sea-going vessels; also as a detector in taking X-ray pictures of the human body).

Present quotations for barytes vary from $7 to $9 per ton, crude, f.o.b. rail-shipping point, depending on quality. Most baryte has to be washed and acid treated to remove iron stains or other impurities before being suitable for paint use.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta and Santa Barbara counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

Total Barytes Production of California.

The first recorded production of barytes in California, according to the statistical reports of the State Mining Bureau, was in 1910. The annual figures are as follows:

Year	Tons	Value	Year	Tons	Value
1910	860	$5,640	1918	100	$1,500
1911	309	2,207	1919	1,501	18,065
1912	564	2,812	1920	3,029	20,795
1913	1,600	3,680	1921	901	4,809
1914	2,000	3,000	1922	3,370	18,925
1915	410	620	1923	2,925	16,058
1916	1,606	5,516	1924	--------	--------
1917	4,420	25,633	1925	--------	--------
			Totals	23,595	$129,260

CLAY (Pottery).

Bibliography: State Mineralogist Reports I, IV, IX, XII-XV, XVIII-XXII (inc.). Bulletin 38. Preliminary Report No. 7. U. S. Bureau of Standards, Tech. Paper No. 262.

At one time or another in the history of the state, pottery clay has been quarried in thirty-three of its counties. Of these, 20 contributed in 1925. In this report, 'pottery clay' refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flowerpots, floor, faience and ornamental tiling, architectural terra cotta, sewer pipe, drain and roof tile, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form or was immediately used in the manufacture of any of the above finished products by the producer. It does not include clay used in making brick and hollow building blocks.

There are many other important uses for clays besides pottery manufacture. Among these may be enumerated paper, cotton goods, and chemicals. Being neutral, clay does not have an injurious effect upon other constituents used in the manufacture of such articles. In paper making, clay is used as a filler in news and similar grades, and as a coater or glazer in the more highly-finished art papers. A large part of the china clay used in the United States is imported from England. Clays of the montmorillonite and halloysite group ('rock soap') are being utilized successfully in the manufacture of soaps.

During 1925, a total of 58 producers in 20 counties reported an output of 537,587 short tons of pottery clay, having a total value of $674,376 f. o. b. rail-shipping point, for the crude material, as compared with the 1924 production of 417,928 tons worth $651,858.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures, much care is required to avoid duplications. So far as we have been able to segregate the figures, from the data sent in by the operatives, we have credited the clay output to the counties from which the raw material originated; and have deducted tonnages used in brick manufacture, as bricks are classified separately, herein.

A tabulation of the direct returns from the producers, by counties, for the year 1925, is shown herewith:

Pottery Clay, in 1925.

County	Tons	Value	Used in the manufacture of—
Alameda	9,300	$11,376	Drain, floor, faience, hand made and roofing tile, sewer and chimney pipe, flue lining.
Amador	63,889	95,946	Kalsomine, refractories, roofing tile, saggers, sanitary ware, sewer pipe, and various.
Los Angeles	217,707	106,817	Drain, faience, floor, roofing tile, sewer pipe, flue lining, fire clay, electrical conduit, refractories, various and oil well mudding.
Monterey	414	1,161	Floor and roofing tile.
Orange	13,431	42,562	Refractories, drain tile and various.
Placer	102,598	138,813	Architectural terra cotta, sewer and chimney pipe, flue lining, drain, floor and roofing tile, and various.
Riverside	74,789	155,315	Sewer pipe, drain tile, refractories, stoneware, and various.
Sacramento	1,363	2,748	Drain tile and various.
San Bernardino	[a]1,540	11,000	Porcelain.
San Diego	[b]26,976	66,427	Porcelain, stoneware, floor tile, architectural terra cotta, and various.
Santa Barbara	2,390	5,800	Drain, floor and roofing tile.
Santa Clara	1,516	3,216	Red earthenware, sewer pipe, roofing and drain tile.
Calaveras, Contra Costa, Fresno, Humboldt, Kern, Marin, Merced, Sonoma*	21,674	33,195	Drain and roofing tile, sewer and chimney pipe, flue lining, architectural terra cotta, crushed brick for roofing, porcelain and various.
Totals	537,587	$674,376	

*Combined to conceal output of a single operator in each.

[a] Includes kaolin.

[b] Includes 'Cornwall' stone.

Pottery Clay Products.

The values of the various pottery clay products made in California during 1925 totaled $13.621.431, compared with $12.015.361 in 1924, their distribution being shown in the following tabulation:

Product	*Number of producers*	*Tons*	*Value*
Architectural terra cotta	6	17,068	$2,677,855
Chimney pipe, terra cotta and flue lining	9	14,484	535,887
Drain tile	13	7,733	126,360
Roofing tile	18	48,327	1,394,108
Sewer pipe	10	88,360	2,217,151
Stoneware and chemical stoneware	6	----	362,370
Sanitary ware	5	----	2,178,623
Chinaware and semi-vitreous tableware	3	----	569,182
Red earthenware	6	----	164,071
Floor, faience, mantel, glazed and hand-made tile	20	----	2,419,583
Miscellaneous art pottery, bisque doll heads and chinaware, porcelain, cement, brick dust, glass tank blocks, garden furniture, crushed tile, electrical conduit, conduit pipe, fire tile and ground fire clay	14	----	976,241
Total value			$13,621,431

Important increases were shown by several of the above groups, particularly chimney pipe, sewer pipe, roofing tile, and flat tile (floor, faience, mantel, etc.).

Pottery Clay Production of California, by Years.

Amount and value of crude pottery clay output in California since 1887 are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	75,000	$37,500	1907	160,385	$254,454
1888	75,000	37,500	1908	208,042	325,147
1889	75,000	37,500	1909	299,424	465,647
1890	100,000	50,000	1910	249,028	324,099
1891	100,000	50,000	1911	224,576	252,759
1892	100,000	50,000	1912	199,605	215,683
1893	24,856	67,284	1913	231,179	261,273
1894	28,475	35,073	1914	179,948	167,552
1895	37,660	39,685	1915	157,866	133,724
1896	41,907	62,900	1916	134,636	146,538
1897	24,592	30,290	1917	166,298	154,602
1898	28,947	33,747	1918	112,423	166,788
1899	40,600	42,700	1919	135,708	245,019
1900	59,636	60,956	1920	203,997	440,689
1901	55,679	39,144	1921	225,120	362,172
1902	67,933	74,163	1922	277,232	473,184
1903	90,972	99,907	1923	376,863	697,841
1904	84,149	81,952	1924	417,928	651,857
1905	133,805	130,146	1925	537,587	674,376
1906	167,267	162,283	Totals	5,909,323	$7,636,134

DOLOMITE.

Bibliography: Reports XV, XVII–XXII (inc.). Bulletins 67, 91.

The production of dolomite for the year 1925 totaled 42,852 tons valued at $104,900, being an increase in both quantity and value over the 1924 figures of 28,843 tons and $81,271, though less than the record yield of 1923. The 1925 output came from two quarries in Inyo County and one each in San Benito and Tuolumne. The material shipped was utilized for steel furnace flux and refractories, for manufacture of CO_2, burned dolomitic lime, for stucco dash-coat, and terrazzo.

Dolomite Production of California, by Years.

Previous to the 1915 statistical report of the State Mining Bureau, dolomite was included under limestone, as the two minerals are closely related chemically; but since dolomite, as such, has been found to have certain distinctive applications, we have given it a separate classification.

Amount and value of the output of dolomite, annually, have been as follows:

Year	Tons	Value
1915	4,192	$14,504
1916	13,313	46,566
1917	27,911	66,416
1918	24,560	79,441
1919	24,502	67,953
1920	42,388	132,791
1921	31,195	99,155
1922	52,409	114,911
1923	69,519	142,615
1924	28,843	71,271
1925	42,852	104,900
Totals	361,684	$940,523

FELDSPAR.

Bibliography: State Mineralogist Reports XV, XVII, XVIII, XXI. Bulletins 67, 91. U. S. Bureau of Mines, Bulletin 92. Eng. & Min. Jour.-Press, Vol. 115, pp. 535–538, Mar. 24, 1923.

Feldspar was produced by eight operators in three counties (Kern, Riverside, and San Diego) during 1925, to the amount of 8165 tons, valued at $59,615, being a slight decrease both in quantity and value from the 1924 figures, which were 9055 tons and $68,112.

The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20%, and in some cases the potters specify less than 5%. An important factor, also, is the iron-bearing minerals frequently present in pegmatites and granites, such as biotite (black mica), garnet, hornblende, and black tourmaline. Feldspar for pottery uses should be practically free of these. The white, potash-mica, muscovite, is not particularly objectionable except that, being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar.

Present quotations are from $5 to $8 per ton, crude, according to quality.

The most important recent developments in the feldspar resources of California have taken place in San Diego and Riverside counties, where large deposits of massive, high-grade spar are being opened up. These deposits are unusually free from black mica and other deleterious iron-bearing minerals objectionable in pottery work. The important producing districts are near Lakeside and Campo, in San Diego County, and near Lakeview, Murrietta, and Elsinore, in Riverside County. No recent shipments have been reported from Monterey and Tulare counties, formerly important sources.

Total Feldspar Production of California.

Total amount and value of feldspar production in California since the inception of the industry are given in the following table, by years:

Year	Tons	Value	Year	Tons	Value
1910	760	$5,720	1919	1,272	$12,965
1911	740	4,560	1920	4,518	26,189
1912	1,382	6,180	1921	4,349	28,343
1913	2,129	7,850	1922	4,587	37,109
1914	3,530	16,565	1923	11,100	81,800
1915	1,800	9,000	1924	9,055	68,112
1916	2,630	14,350	1925	8,165	59,615
1917	11,792	46,411			
1918	4,132	22,061	Totals	71,941	$446,825

FLUORSPAR.

Bibliography: State Mineralogist Reports XVII, XVIII. Bulletins 67, 91. Eng. & Min. Jour.-Press, Vol. 117, pp. 489–492, Mar. 22, 1924.

Fluorspar, or calcium fluoride, CaF_2, is one of the most important non-metallic minerals from an industrial standpoint. About 80% of the commercial mineral is prepared in the 'gravel' form and utilized as a flux in the manufacture of steel, for which use no substitute has yet been found. In the United States, under normal business conditions, the consumption for that purpose is 125,000 to 150,000 tons annually. Fluorspar is also used in aluminum smelting, and in the manufacturing of enameled ware, glazed tile and brick, opalescent glass and certain chemicals, particularly hydrofluoric acid and its derivatives. The mineral is marketed in three forms: lump, gravel, and ground.

[1] "Of the three physical forms of fluorspar of commerce, lump, gravel, and ground, two grades of each form are marketed. Lump and gravel are sold as metallurgical or fluxing grades, and acid grades; ground is sold as glass-enamel-ceramic grade, and acid grade. Lump spar of either grade should not be too large, and small lump, not exceeding 6 in. in diameter, is preferred by the trade. Specifications for physical form of metallurgical lump spar demand a minimum content of gravel fluorspar, as fines, in any carload, say not exceeding one ton. Metallurgical gravel spar should not be too fine, and coarse gravel with minimum content of fluorspar sand, as fines, is more acceptable to the trade. Size specifications for metallurgical gravel spar demand that it shall pass through a 1-in. ring.

"The market specifications for standard fluorspar in any form are mainly chemical and governed by analysis. Guaranteed analysis for standard metallurgical or fluxing grade spar, lump or gravel, is minimum of 85 per cent calcium fluoride, and maximum of 5 per cent silica. Merchantable grade acid-spar, lump, gravel and ground, varies somewhat with different users. Not exceeding 2 per cent silica and under 97 per cent calcium fluoride are the limits. Part of the trade insists on a guaranteed minimum of 98 per cent calcium fluoride and maximum of 1 per cent silica, though some consumers are satisfied with a guaranteed minimum of 97 per cent calcium fluoride and maximum of 2 per cent silica. Glass-enamel-ceramic grade ground fluorspar specifications are flexible, the users of that class of spar particularly demanding fine grinding, preferably 150 to 200 mesh, and thorough washing free from alumina; also freedom from contamination of metallic ores and barytes. Analyses for glass-enamel-ceramic spar vary from 90 to 95 per cent calcium fluoride, 2 to 5 per cent silica, and 2 to 8 per cent calcium carbonate.

"The usual impurities in fluorspar are silica and calcium carbonate, which are penalized, as a rule. Minor impurities in fluorspar are ores of lead and zinc, generally the sulphides, and pyrites and barytes, all of which are objectionable, and sometimes penalized.

---

[1] Reed, A. H., Marketing of fluorspar: Eng. & Min. Jour.-Press, Vol. 117, p. 489, Mar. 22, 1924.

"No premiums are allowed on fluorspar shipments, but there is a penalty for inferior material. Trade specifications demand that for each point of calcium fluoride less than 85 per cent there shall be deducted 1/85th of the delivered cost, and for each point of silica over 5 per cent there shall be deducted 1/40th of the delivered cost."

According to the U. S. Bureau of Foreign and Domestic Commerce, imports of fluorspar into the United States in 1925 amounted to 43,482 long tons, valued at $468,847, and came principally from England, with smaller amounts from British South Africa, Italy, China, and Netherlands. Domestic shipments of fluorspar, according to the U. S. Geological Survey, totaled 113,669 short tons, valued at $2,052,342.

In California deposits have been reported in Los Angeles, Mono, Riverside and San Bernardino counties, but no commercial production has resulted except in 1917–1918, when a total of 79 tons valued at $991 was shipped from Riverside County.

The Tariff Act of 1922 places a duty of $5.60 per ton on foreign importations of fluorspar.

Present quotations (Engineering and Mining Journal-Press, New York) are f.o.b. Middle Western Mines, per net ton: Gravel, not less than 85% CaF_2 and not over 5% SiO_2, $18; foundry lump, $20.

FULLER'S EARTH.

Bibliography: State Mineralogist Reports XIV, XVII, XVIII, XXI. Bulletins 38, 91. U. S. Bureau of Mines, Bulletin 71. Eng. & Min. Jour.-Press, Vol. 121, pp. 837–842, May 22, 1926.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color, and some varieties disintegrate in water. In California, fuller's earth has been used in clarifying both refined mineral and vegetable oils, and for special chemical purposes; although its original use was in fulling wool, as the name indicates. Production has come mainly from Calaveras and Solano counties, with other deposits noted also in Riverside, Fresno, Inyo, and Kern counties.

Clays of the montmorillonite and halloysite group ('rock soap') are being utilized by some of the oil refineries in lieu of true fuller's earth in the refining of petroleum products.

The production of 5280 tons valued at $91,842 here credited to 1925 as 'fuller's earth' is in reality colloidal clay of the montmorillonite class (sold under such local names as 'bentonite,' 'otaylite,' 'shoshonite,' derived from the locality where found). Because of its being utilized for clarifying, filtering, and cleanser purposes, most of it in petroleum refining, we have placed it, for the purpose of the State Mining Bureau's statistical reports, under the fuller's earth heading.

After all, the practical test of a fuller's earth is not so much chemical, as a physical one; that is, its physical capacity to adsorb basic colors and to remove these colors from solution in animal, vegetable, or mineral oils, also from water.

The 1925 output above noted is a slight decrease in amount from the 5290 tons but an increase in value over the figure of $67,295 in 1924, and came from five properties, in Inyo, Kern, San Bernardino, and San Diego counties.

The industrial applications of the montmorillonite (or 'bentonite,' as it is more commonly referred to) group of clays are numerous. According to Melhase:[1]

"Bentonite has been used to a limited extent in soaps and detergent preparations, in paints, pigments, and stove polish. Tests indicate that it may have a further field of usefulness in the manufacture of cements and plasters, in the ceramic industry, and in the preparation of dyes, emulsions, explosives, and fertilizers. Horticultural sprays, animal dips, lubricants, and absorbents may employ bentonite as an ingredient. Bentonite is used in de-inking newspapers, in foundry work, in the manufacture of pencils, crayons, and ink, and in the preparation of various pharmaceuticals and cosmetics.

"Bentonites in which the characterizing mineral is leverrierite are extensively used in the preparation of water softeners. The California bentonites are used chiefly by local refineries for cleaning heavy lubricating oils, kerosene, and gasoline. In preparing the bentonite for this purpose, it is first dried at a temperature of 230 deg. F. It is then ground to an impalpable powder and treated for several hours with 96 per cent sulphuric acid, about 45 per cent by weight of acid being found more efficient. The acid-soluble impurities being thus eliminated, the clay is then drained and thoroughly washed with clean water.

"Refining Processes.

"The prepared clay is then placed in agitators together with the oil to be treated and the mixture thoroughly agitated with steam at 240 to 300 deg. F. From the agitators the mixture goes to settling tanks and then to filter presses, which remove the suspended clay from the now decolorized oil. The amount of clay used ranges from 1 lb. per barrel for gasoline to 100 lb. per barrel for dark, heavy, lubricating oils. The efficiency of acid-treated bentonite is much greater than that of fuller's earth.

"When used in the treatment of gasoline or light oils the clay may be used several times without rejuvenation, but with the darker oils it becomes necessary to wash and rejuvenate the clay after each application. This process cannot, however, be continued indefinitely, as the clay loses a portion of its efficiency with each rejuvenation, and after the third treatment it is found more satisfactory to replace the old clay with a fresh supply."

Fuller's Earth Production of California, by Years.

Fuller's earth was first produced commercially in this state in 1899, and the total amount and value of the output since that time are as follows:

Year	Tons	Value
1899	620	$12,400
1900	500	3,750
1901	1,000	19,500
1902	987	19,246
1903	250	4,750
1904	500	9,500
1905	1,344	38,000
1906	440	10,500
1907	100	1,000
1908	50	1,000
1909	459	7,385
1910	340	3,820
1911	466	5,294
1912	876	6,500
1913	460	3,700
1914	760	$5,928
1915	692	4,002
1916	110	550
1917	220	2,180
1918	37	333
1919	385	3,810
1920	600	6,000
1921	1,185	8,295
1922	6,606	48,756
1923	3,650	55,125
1924	5,290	67,295
1925	5,280	91,842
Totals	33,207	$440,461

NOTE.—Above production since 1921 has been montmorillonite (hydrous aluminum silicate) a collodial clay, sometimes called 'rock soap' and 'bentonite,' and in part locally called 'shoshonite' from its being found near Shoshone in Inyo County; and in part 'otaylite' from Otay, San Diego County.

GEMS.

Bibliography: State Mineralogist Reports II, XIV, XV, XVII, XVIII, XX, XXI. Bulletins 37, 67, 91. U. S. G. S., 'Mineral Resources of the U. S.': Bull. 603, p. 208. Bull. Dept. Geol.

---

[1] Melhase, John. Mining bentonite in California: Eng. & Min. Jour.-Press, Vol. 121, p. 842, May 22, 1926.

Univ. of Cal., Vol. 5, pp. 149–153, 331–380. Am. Jour. Sci., Vol. 31, p. 31.

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to the widely scattered places at which stones are gathered and marketed for the most part in a small way. The material reported in 1925 totaled $10,663 in value, compared with $4,800 in 1924; the increase being due mainly to San Diego County.

The following table shows the distribution of rough, uncut gem and jeweler's materials during 1925:

County	*Value*	*Kind*
San Diego	$9,413	Tourmaline, spessartite garnet, hyacinth, pink and aquamarine beryl, quartz, blue topaz.
Butte	* 1,250	Diamonds.
Calaveras		Quartz crystals.
San Mateo		Jasper.
Total value	$10,663	

*Combined to conceal the output of a single operator in each.

Varieties of California's Gem Stones.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano in Amador County; Placerville, Smith's Flat and others in El Dorado County; French Corral, Nevada County; Cherokee Flat, Morris Ravine, and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County.

California *tourmalines* are decidedly distinctive in coloring and 'fire' as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green, also a blue tourmaline has been found.

One of our California gem stones, *bentonite*, has not been found elsewhere; and in but a single locality here: The Dallas Mine in San Benito County.

Kunzite, a gem variety of spodumene, was first found in the Pala district in San Diego County. It has thus far been found in only one locality (Madagascar) outside of California. It is of a lilac color, and is described in detail in Bulletin 37 of the State Mining Bureau.

Beryls of excellent fire and delicate colors are also obtained in the Pala district, of which the *aquamarine* (blue) and *morganite* (pink) varieties deserve special mention. Morganite, like kunzite, has thus far been found elsewhere only in Madagascar.

Californite, or 'California jade,' is a gem variety of *vesuvianite*, and is green or white in color. It is found in Butte, Fresno, and Siskiyou counties.

Stones of precious blue *topaz* of fine quality are being cut from crystals mined in northern San Diego County. They are associated with beryl and blue tourmaline.

Some *rhodondite* has been mined in Siskiyou County, and used for decorative purposes, its value being included in the marble figures.

Chrysoprase has been produced in Tulare County.

Turquoise has been found in the desert section of San Bernardino County, but none produced commercially in recent years.

Sapphires have been reported recently found in San Bernardino and Riverside counties, but not as yet confirmed. A few have been found in stream gravels with diamonds in Butte County.

Rubies have been identified by the laboratory of the State Mining Bureau, occuring in limestone from the Baldy Mountains, San Bernardino County. Thus far no stones of commercial size have been taken out.

Total Production of Gem Materials in California.

The value of the gem output in California annually since the beginning of commercial production is as follows:

Year	Value	Year	Value
1900	$20,500	1914	$3,970
1901	40,000	1915	3,565
1902	162,100	1916	4,752
1903	110,500	1917	3,049
1904	136,000	1918	650
1905	148,500	1919	5,425
1906	497,090	1920	36,056
1907	232,642	1921	10,954
1908	208,950	1922	1,312
1909	193,700	1923	13,220
1910	237,475	1924	4,800
1911	51,824	1925	10,663
1912	23,050		
1913	13,740	Total value	$2,174,487

GRAPHITE.

Bibliography: State Mineralogist Reports XIII, XIV, XV, XVII. Bulletins 67, 91. U. S. G. S., Min. Res., 1914, Pt. II.

Graphite has been produced from time to time in the state, coming principally from Sonoma and Los Angeles counties. It is difficult for these deposits, which must be concentrated, to compete with foreign supplies, which go on the market almost directly as they come from the deposit. Graphite ores are concentrated with considerable difficulty, and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

According to the U. S. Geological Survey, operators in this country who are working disseminated flake deposits must depend on their No. 1 and 2 flake for their profit. Graphite dust is merely a by-product and is salable only at a low price.

The principal value of graphite is on account of its infusibiilty and resistance to the action of molten metals. It is also largely used in the manufacture of electrical appliances, of 'lead' pencils, as a lubricant, as stove polish, paints, and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory. Among the interesting uses for graphite is the prevention of formation of scale in boilers. The action is a mechanical one. Being soft and slippery, the graphite prevents the particles of scale from adhering to one another or to the boiler and they are thus easily removed.

The price increases with the grade of material, the best quality crystalline variety being quoted at present (f.o.b. New York) at 9¢–9½¢ per pound (Ceylon lumps).

The coarser flakes are necessary for crucibles, as they help to bind the clay together in addition to their refractory service. Imports in 1925 from Ceylon, Canada, Madagascar, Mexico and Korea, totaled 17,780 short tons valued at $828,082 compared with 16,380 tons valued at $399,511 in 1924.

Occurrence of graphite has been reported at various times from Calaveras, Fresno, Imperial, Inyo, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne counties.

During 1925 there was a small commercial output of graphite from Inyo County. For several years a single plant in Los Angeles County was concentrating graphite from a disseminated ore, the product being used for paint and for foundry facing.

Graphite Production of California, by Years.

According to the records of the State Mining Bureau, the graphite production of California, by years, has been as follows:

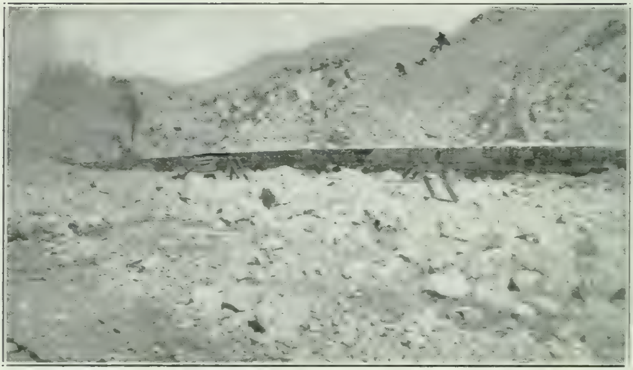
Year	Pounds	Value
1901	128,000	$4,480
1902	84,000	1,680
1903		
1913	2,500	25
1914		
1915		
1916	29,190	2,335
1917	*770,000	37,225
1918		
1919		
1920		
1921	*624,000	26,160
1922		
1923		
1925	*	*
Totals	1,637,690	$71,905

*Annual details concealed under 'Unapportioned,' on account of a single producer.

GYPSUM.

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XXII. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 223, 413, 430, 697.

During 1925, one operator in Imperial County and three in Riverside produced a total of 107,613 tons of gypsum, valued at $172,444, compared with 25,569 tons and $53,210 in 1924 and 86,410 tons worth $188,336 in 1923. The material was utilized mainly in cement manufacture as a retardant, for hard-wall plaster (including wall board), and for fertilizer. The increase over the 1924 figures is due mainly to the larger scale of operations of the Pacific Portland Cement Company's gypsum plant in western Imperial County.



Gypsum deposit of Pacific Portland Cement Company in the Fish Mountains, Imperial County. Photo by W. B. Tucker.

[illegible]-ton plaster mill of Pacific Portland Cement Company at Plaster City, Imperial County. Photo by W. B. Tucker.

Uses.

The most important use of gypsum from the quantity standpoint is in the calcined form where it is utilized in the manufacture of various hard-wall plasters and plaster board. As plaster of paris, it plays a very important part in surgical work. Approximately 2%, by weight, raw gypsum is added in the manufacture of Portland cement just before the final grinding. In this application, the gypsum acts as a retarder to the set of the cement. The use of gypsum tile for non-bearing fireproof partitions, stairway and elevator enclosures, and the protection of steel columns, girders and beams, has increased greatly.

Land plaster may be applied to the soil by drilling, or scattered in the hill, or it may be sowed broadcast, in quantities ranging from 200 to 500 pounds to the acre.

Total Production of Gypsum in California.

Production of gypsum annually in California since such records have been compiled by this Bureau is as follows:

Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1907	8,900	$57,700
1888	2,500	25,000	1908	34,600	155,400
1889	3,000	30,000	1909	30,700	138,176
1890	3,000	30,000	1910	45,294	129,152
1891	2,000	20,000	1911	31,457	101,475
1892	2,000	20,000	1912	37,529	117,382
1893	1,620	14,280	1913	47,100	135,056
1894	2,446	24,584	1914	29,734	78,375
1895	5,158	51,014	1915	20,200	48,953
1896	1,310	12,580	1916	33,384	59,533
1897	2,200	19,250	1917	30,825	56,840
1898	3,100	23,600	1918	19,695	37,176
1899	3,663	14,950	1919	19,813	50,579
1900	2,522	10,088	1920	20,507	92,535
1901	3,875	38,750	1921	37,412	78,875
1902	10,200	53,500	1922	47,084	188,336
1903	6,914	46,441	1923	86,410	289,136
1904	8,350	56,592	1924	25,569	53,210
1905	12,859	54,500	1925	107,613	172,444
1906	21,000	69,000			
			Totals	814,234	$2,681,462

INFUSORIAL and DIATOMACEOUS EARTH.

Bibliography: State Mineralogist Reports II, XII–XVI (inc.), XV, XVII–XXII (inc.). Bulletins 38, 67, 91. Am. Inst. Min. Eng., Bull. 104, August, 1915, pp. 1539–1550. U. S. Bur. of Mines, Rep. of Investigations: Serial No. 2431, Jan., 1923. Eng. & Min. Jour.-Press, Vol. 115, pp. 1152–1154, June 30, 1923.

Infusorial and diatomaceous earths—sometimes called tripolite—are very light and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which have been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. The principal commercial use of this material is as an absorbent. It is also employed in the manufacture of scouring soap and polishing powders; for filtration purposes; in making some classes of refractory brick; and as an insulating medium both in heating and refrigeration. It is a first-class nonconductor of heat, where high temperatures are employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name 'kieselguhr,' it was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

As a nonconductor of heat it has been used alone or with other materials as a covering for boilers, steam pipes and safes, and in fireproof cements. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. It has been used for absorbing liquid manures so that they could be utilized as fertilizers, and as a source of silica in making water-glass as well as in the manufacture of cement, tile glazing, artificial stone, ultramarine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard-rubber objects, matches, and papier maché, and for solidifying bromide. For making insulating brick the material is sawed into blocks, and for all other purposes it is ground and screened.

The most important deposits in California thus far known are located in Monterey, Orange, San Luis Obispo, and Santa Barbara counties. The Santa Barbara material is diatomaceous and is of a superior quality, particularly for filtration uses which bring the higher prices. Infusorial or diatomaceous earths are also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma, and Tehama counties.

As over 90% of the output in California is from a single operator, we have concealed the exact figures under the 'Unapportioned' item in the state and county totals. There were nine operators in 1925 in Monterey, Santa Barbara, and Shasta counties, the shipments showing an increase in tonnage, but a decrease in total value compared with 1924.

The material shipped was utilized for insulation, filtration, paint pigment, and for clarification of gasoline and kerosene.

Total Production of Diatomaceous Earth in California.

The first recorded production of these materials in California occurred in 1889; total amount and value of output, to date, are as follows:

Year	Tons	Value	Year	Tons	Value
1889	39	$1,335	1908	2,950	$32,012
1890	----------	----------	1909	500	3,500
1891	----------	----------	1910	1,843	17,617
1892	----------	----------	1911	2,194	19,670
1893	50	2,000	1912	4,129	17,074
1894	51	2,040	1913	8,645	35,968
1895	----------	----------	1914	12,840	80,350
1896	----------	----------	1915	12,400	62,000
1897	5	200	1916	15,322	80,649
1898	----------	----------	1917	24,301	127,510
1899	----------	----------	1918	35,963	189,459
1900	----------	----------	1919	40,200	217,800
1901	----------	----------	1920	60,764	1,056,260
1902	422	2,532	1921 1922	*90,739	1,016,675
1903	2,703	16,015			
1904	6,950	[illegible]	1923 1924 1925	*193,064	524,0[illegible]
1905	3,000	15,000			
1906	2,430	14,400			
1907	2,531	[illegible]	Totals	5,729,73[illegible]	$8,851,[illegible]

*Annual details concealed under 'Unapportioned.'

LIMESTONE.

Bibliography: State Mineralogist Reports IV, XII–XV (inc.), XVII–XXII (inc.). Bulletins 38, 91. Oregon Agr. College, Extension Bulletin 305. Eng. and Min. Jour.-Press, Vol. 120, pp. 249–253.

'Industrial' limestone was produced in eleven counties during 1925, to the amount of 319,977 tons, valued at $494,525, being an increase in quantity but a drop in value compared to the 1924 output of 219,476 tons, worth $582,660.

The amount here given does not include the limestone used in the manufacture of cement nor for macadam and concrete, nor of lime for building purposes: but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel,' paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken grit, carbon dioxide gas, 'paving compound,' facing dust for concrete pipe, also for rubber and magnesite mix. That indicated in the table below as coming from Santa Clara and Los Angeles counties is calcareous marl sold for agricultural purposes. Of the total product in 1925, approximately 12,000 tons, valued at $46,250, was used for agricultural purposes.

Distribution of the 1925 output was as follows:

County	*Tons*	*Value*
El Dorado	228,293	$297,127
San Bernardino	13,239	27,569
Santa Cruz	16,551	33,102
Shasta	24,395	28,480
Tulare	13,300	43,900
Contra Costa, Inyo, Los Angeles, Santa Clara, Siskiyou, Tuolumne*	24,199	64,347
Totals	319,977	$494,525

*Combined to conceal output of a single operator in each.

Limestone Production of California, by Years.

The following tabulation gives the amounts and value of 'industrial' limestone produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. These tonnages consist principally of limestone utilized for flux, glass and sugar making, agricultural, chemical, and other special industrial purposes. That utilized in cement manufacture is not included.

Year	Tons	Value	Year	Tons	Value
1894	15,420	$19,275	1911	516,398	$452,790
1895	71,355	71,690	1912	613,375	570,248
1896	68,184	71,112	1913	301,918	274,455
1897	36,796	38,556	1914	572,272	517,713
1898	27,686	24,548	1915	146,324	156,288
1899	30,769	29,185	1916	187,521	217,733
1900	32,791	31,532	1917	237,279	356,396
1901	76,937	99,445	1918	208,566	456,258
1902	71,422	90,524	1919	88,291	248,145
1903	125,919	163,988	1920	90,120	298,197
1904	40,207	87,207	1921	75,921	305,912
1905	192,749	323,325	1922	84,382	282,181
1906	80,262	162,827	1923	143,266	348,464
1907	230,985	406,041	1924	219,476	582,660
1908	273,890	297,264	1925	319,977	494,525
1909	337,676	419,921			
1910	684,635	581,208	Totals	6,202,769	$8,479,613

LITHIA.

Bibliography: State Mineralogist Reports II, IV, XIV, XXI. Bulletins 38, 67, 91.

Lithia mica, lepidolite (a silicate of lithium et al.) utilized in the manufacture of artificial mineral water, fireworks, glass, etc., has been mined in San Diego County since 1899, except between 1905 and 1915, though there was none shipped in 1925. Some amblygonite, a lithium phosphate, is occasionally also obtained from pockets associated with the gem tourmalines.

Lithia mica total production in the state has been as follows:

Year	Tons	Value	Year	Tons	Value
1899	124	$4,600	1917	880	$8,800
1900	440	11,000	1918	4,111	73,998
1901	1,100	27,500	1919	800	14,400
1902	822	31,880	1920	10,046	153,502
1903	700	27,300	1921	*1,365	20,781
1904	641	25,000	1922		
1905	25	276	1923		
1906			1924	109	2,269
1915	91	1,365			
1916	71	1,065	Totals	21,325	$403,736

*Annual details concealed under 'Unapportioned.'

MICA.

Bibliography: State Mineralogist Reports II, IV. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 740; Min. Res. of U. S. Eng. & Min. Jour.-Press, Vol. 115, pp. 55–60, Jan. 13, 1923.

No commercial production of mica has recently been reported in California. Production in previous years has been as follows:

Year	*Tons*	*Value*
1902	50	$2,500
1903	50	3,800
1904	50	3,000
Totals	150	$9,300

Classification and Uses.

Practically all marketable mica is of the muscovite or phlogopite varieties. There are three main commercial classes: Sheet mica, including punch; splittings, and scrap. Sheet mica is used chiefly for electrical purposes and for glazing; splittings are made into built-up mica; scrap is ground to a powder. Mica to be classified as sheet must yield a rectangle of at least 1½ x 2 in., must split evenly and freely, be free from cracks, rulings, or plications, and reasonably free from inclusions of foreign matter, though stains of a nonconducting character are permissible for some uses. Ability to withstand heat and high electrical resistance have led to a wide application of sheet mica in the electrical industries. The electrical uses of sheet mica greatly exceed all others in quantity and value of the material used.

As a heat-resisting transparent medium, sheet mica has various uses. It is widely employed for stove windows, though this use has declined to a considerable extent. A hard and rigid mica that is nearly clear is best suited for stove fronts. High-grade stove mica commands a higher price than electrical mica, because for the most part larger sizes are demanded. Mica is also used in furnace and bake-oven sight-holes, heat screens, lamp chimneys, canopies and shades, particularly for gas mantles, and also for military lanterns and in lantern slides.

Its ability to withstand shocks and strains, combined with its transparency, has led to wide use in motor goggles, spectacles, diver's helmets, smoke helmets, compass cards, gage fronts, and in windows subject to shock, as in the conning towers of warships. On account of its heat-resisting qualities, ground mica is used in railroad car axle packings, in pipe and boiler coverings, in fire-proof paints, and in rubber tires. Ground mica is used as a component in roofing, as a filler in rubber and other products, in calico printing, and as a tire powder. It is used also in tinsel decorations, and as 'Santa Claus snow' for Christmas tree and window decorations. It is used as a lubricant for wooden bearings, and mixed with oil for metal bearings.

MINERAL PAINT.

Bibliography: State Mineralogist Reports XII-XIX (inc.), XXI, XXII. Bulletins 38, 91.

Mineral paint materials were produced in California in 1925 from properties in Stanislaus County, amounting to 669 tons valued at $6,969. This is an increase over the 532 tons and $5,234 of 1924, and was entirely of yellow ochre. Hematite has been shipped from Placer County, and red ochre from Sonoma and Ventura counties in former years.

Mineral Paint Production of California, by Years.

The first recorded production of mineral paint materials in the state was in the year 1890. The output, showing annual amount and value, since that time, is given herewith:

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1909	305	$2,325
1891	22	880	1910	200	2,040
1892	25	750	1911	186	1,184
1893	590	26,795	1912	300	1,800
1894	610	14,140	1913	303	1,780
1895	750	8,425	1914	132	847
1896	395	5,540	1915	311	1,756
1897	578	8,165	1916	643	3,960
1898	653	9,698	1917	520	2,700
1899	1,704	20,294	1918	728	4,738
1900	529	3,993	1919	1,780	17,055
1901	325	875	1920	779	8,477
1902	589	1,533	1921	446	4,748
1903	2,370	3,720	1922	1,620	13,277
1904	270	1,985	1923	1,049	11,773
1905	754	4,025	1924	532	5,234
1906	250	1,720	1925	669	6,969
1907	250	1,720			
1908	335	2,250	Totals	20,942	$200,851

MINERAL WATER.

Bibliography: State Mineralogist Reports VI, XII-XVIII (inc.), XXI. U. S. G. S., Water Supply Paper 338. Min. Res. 1914, 1916. 'Mineral Springs and Health Resorts of California,' by Dr. Winslow Anderson, 1890. U. S. Dept. of Agr., Bur. of Chem., Bulletin 91.

A widespread production of mineral water is shown annually in California. These figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having a special medicinal value brings a price many times higher than the average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing.

From a therapeutic standpoint, California is particularly rich in mineral springs. The counterparts of many of the world-famed spas of Europe and the eastern United States can be found here. Radioactivity has been noted in at least two localities in California: At The Geysers in Sonoma County, and Arrowhead Hot Springs in San Bernardino County. It doubtless exists at others, but the State Mining Bureau has not as yet had funds available to conduct the necessary investigations along this line.

So far as the efficacy of radioactivity in mineral water is concerned, it has been found by investigations of the U. S. Geological Survey and the U. S. Department of Agriculture that it is not retained and transported in bottled water. Radioactivity in water is only temporary, and dissipates. To obtain whatever therapeutic effect it may possess, radioactive water should be utilized directly at the spring.

Commercial production of mineral water in California for 1925 amounted to a total of 12,115,072 gallons valued at $1,230,455, being a new high record both in quantity and value. The 1925 output was distributed by counties, as follows:

County	*Gallons*	*Value*
Butte	4,484	$2,742
Lake	62,970	57,793
Los Angeles	3,811,270	336,038
Napa	63,836	44,251
San Diego	81,374	21,137
Sonoma	19,963	6,679
Calaveras, Colusa, Contra Costa, Fresno, Humboldt, Marin, Riverside, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Santa Clara, Siskiyou, Solano*	8,071,165	761,915
Totals	12,115,072	$1,230,455

*Combined to conceal output of a single operator in each.

The production above tabulated was in part bottled with artificial carbonation, in part natural and a large part was used in the preparation of soft drinks with flavors.

Although some of the operators complain that prohibition has all but killed off the mineral water business, the reports of actual production of mineral water bottled and sold indicate an encouraging growth and a material increase annually both in total quantity and value, as may be noted from the tabulation below.

Mineral Water Production of California, by Years.

Mineral water was bottled for sale, at the Napa Soda Springs, Napa County, as early as 1860, and at other springs in California, notably The Geysers, Sonoma County, also at early dates; but there are no figures available earlier than the year 1887. Amounts and values, annually, since that year are shown herewith:

Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1907	2,924,269	$544,016
1888	1,112,202	252,990	1908	2,789,715	560,507
1889	808,625	252,241	1909	2,449,834	465,488
1890	258,722	89,786	1910	2,335,259	522,009
1891	334,553	139,959	1911	2,637,669	590,654
1892	331,875	162,019	1912	2,497,794	529,384
1893	383,179	90,667	1913	2,350,792	599,748
1894	402,275	184,481	1914	2,443,572	476,169
1895	701,397	291,500	1915	2,274,267	467,738
1896	808,843	337,434	1916	2,273,817	410,112
1897	1,508,192	345,863	1917	1,942,020	340,566
1898	1,429,809	213,817	1918	1,808,791	375,650
1899	1,338,537	406,691	1919	2,233,842	340,117
1900	2,456,115	268,607	1920	2,391,791	421,643
1901	1,555,328	559,057	1921	3,446,278	367,476
1902	1,701,142	612,477	1922	4,276,346	486,424
1903	2,056,340	558,201	1923	5,487,276	616,919
1904	2,430,320	496,946	1924	8,159,211	
1905	2,194,150	538,700	1925	12,115,072	
1906	1,585,690	478,186	Totals	90,853,071	$1[illegible],787,791

PHOSPHATES.

Bibliography: State Mineralogist Report XXI. Bulletins 67, 91.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithium phosphate, amblygonite, Li (AlF) PO_4, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia.

PUMICE and VOLCANIC ASH.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XVIII, XXII. Bulletin 38 (See 'Tufa').

The production of pumice and volcanic ash for the year 1925 amounted to 5319 tons valued at $32,937, and came from properties in Imperial, Inyo, Kern, and Mono counties. This is an increase in tonnage but slightly lower value compared with the 1924 shipments which were 4919 tons worth $33,404.

The material from Imperial County and part of that from Mono is of the vesicular, block variety and was sold for abrasive purposes; the balance of the Mono material and that from Inyo and Kern was the volcanic ash, or tuff variety, and was employed in making soap and cleanser compounds. The Kern County ash is going into the preparation of one of the popular and nationally advertised brands of cleanser compounds.

Pumice Production of California, by Years.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which year there has been a small annual output, as indicated by the following table:

Year	Tons	Value	Year	Tons	Value
1909	50	$500	1918	2,114	$28,669
1910			1919	2,388	43,657
1911			1920	1,537	25,890
1912	100	2,500	1921	406	6,310
1913	3,590	4,500	1922	613	4,248
1914	50	1,000	1923	2,936	16,309
1915	380	6,400	1924	4,919	33,404
1916	1,246	18,092	1925	5,319	32,937
1917	525	5,295	Totals	26,173	$229,711

PYRITES.

Bibliography: State Mineralogist Reports XVIII, XIX, XXII. Bulletins 38, 91. Min. and Sci. Press, Vol. 114, pp. 825, 840.

A total production of 129,500 short tons of pyrites, valued at $528,550, was reported shipped in California during 1925 from properties in Alameda, Mariposa, and Shasta counties. This was a slight increase both in tonnage and value over the figures of 124,214 tons and $517,835 in 1924.

The material was mostly used in the manufacture of sulphuric acid for explosives and fertilizers, but a portion was utilized directly in the preparation of agricultural fertilizer and insecticide. The sulphur content ranged up to 46.5% S.

This does not include the large quantities of pyrite, chalcopyrite and other sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates while under treatment for their precious metal values.

Pyrites Production in California, by Years.

The total recorded pyrites production in California to date is as follows:

Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1912	69,872	$203,470
1899	5,400	28,620	1913	79,000	218,537
1900	3,642	21,133	1914	79,267	230,058
1901	4,578	18,429	1915	92,462	293,148
1902	17,525	60,306	1916	120,525	372,969
1903	24,311	94,000	1917	111,325	323,704
1904	15,043	62,992	1918	128,329	425,012
1905	15,503	63,958	1919	147,024	540,300
1906	46,689	145,895	1920	146,001	530,581
1907	82,270	251,774	1921	110,025	473,735
1908	107,081	610,335	1922	151,381	570,425
1909	457,867	1,389,802	1923	148,004	555,308
1910	42,621	179,862	1924	124,214	517,835
1911	54,225	182,954	1925	129,500	528,550
			Totals	2,519,684	$8,923,742

SHALE OIL.

Bibliography: State Mineralogist Report XIX. U. S. Geol. Surv., Bulletins 322, 729. U. S. Bur. of Mines, Bull. 210. Eng. and Min. Jour.-Press, Vol. 118, No. 8, pp. 290–292, Aug. 23, 1924. Chem. & Met. Eng., Vol. 32, No. 6, Feb., 1925. Min. Congress Jour., Dec., 1924.

Oil Shale is defined by Gavin,[1] as follows:

> "Oil shale is a compact, laminated rock of sedimentary origin, yielding over 33 per cent of ash and containing organic matter that yields oil when distilled, but not appreciably when extracted with the ordinary solvents for petroleum.
>
> * * * * * * *
>
> "Oil shales contain a substance, or substances, usually classed as a pyro-bitumen, that by destructive distillation, or pyrolysis, yields oils somewhat similar to petroleum. These substances have been termed 'kerogen,' from two Greek words meaning producer of wax."

The Scottish oil shales are also known as 'torbanite.'

The so-called 'oil shales' of California do not for the most part conform to the above definition, as the greater part of the oil obtained from them occurs as such and can be extracted by suitable solvents. The most extensive deposits in this state are part of the Monterey formation of Tertiary age, and physically and chemically are different from the oil shales of Scotland and from other oil shales in the United States. The mineral matter of this shale is diatomaceous; the beds that yield oil occur in massive formation; and when freshly broken smell strongly of petroleum. Most geologists consider the Monterey shales to have been the origin of the oil in some of the oil fields of California.

Although the extraction of shale oil has been a matter of commercial practice on a considerable scale for many years in Scotland, France, and Australia, it has not attained any great commercial importance as yet in the United States. Technical knowledge of the subject, however, is increasing. With the gradual depletion of the underground reserves of liquid oil, it is merely a matter of time until the development of the oil shales of the United States will be an economic necessity. The selling price of petroleum will be the determining factor. The recovery of by-product ammonium sulphate is an important feature of the process.

Two plants on a more or less experimental scale have been in operation in California for several years past, with commercial production beginning in a small way in 1922. The product, in part, has been sold for utilization as a flotation oil in metallurgical work, and part has been consumed as fuel at the plants. Both plants report output for 1925, the amount and value being concealed under the 'unapportioned' item.

Shale Oil Production of California, by Years.

Year	*Barrels*	*Value*
1922 1923 *	4,333	$44,262
1924 1925 *	8,688	55,240
Totals	13,021	$99,502

*Annual details concealed under 'Unapportioned."

---

[1] Gavin, M. J., Oil shale, an historical, technical, and economic study: U. S. Bur. of Mines, Bull. 210, p. 26, 1924.

SILICA (Sand and Quartz).

Bibliography: State Mineralogist Reports IX, XIV, XV, XVII, XVIII, XX, XXI. Bulletins 38, 67, 91.

We combine these materials because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

A portion of the tonnage of vein quartz in California in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. At present, some is utilized as a foundry flux, and for steel-casting molds. A portion of the silica sold (both sand and quartz) is also used in glazes for porcelain, pottery and tile, and in the body of the ware to diminish shrinkage; and some of the sand for the preparation of sodium silicate ('water glass'). Manufacturers of paint use finely ground silica, which forms as much as one-third of the total pigment in some paints. For certain purposes finely-ground crystalline material is superior in paints to other materials because of the angularity of the grains, which makes them adhere more firmly to the article painted and after wear afford a good surface for repainting. The same angularity makes artificially comminuted crystalline quartz superior to natural sand for use in wood fillers. It is also preferable for soaps and polishing powders. Part of the 1925 output was used for roofing and stucco-dash granules.

We do not include under this heading such forms of silica as: quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of 'rock crystal,' amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations.

The production of silica in California in 1925 amounted to 12,498 tons valued at $96,780, from thirteen properties in seven counties.

Of the above total 2,334 tons was of sand, and 10,164 tons of vein and boulder quartz. For making the higher grades of glass, most of the sand is imported from Belgium. There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used as yet owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, El Dorado, Los Angeles, Mono, Monterey, Orange, Placer, Riverside, San Diego, San Joaquin, and Tulare, the chief centers being Amador, Monterey, and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such, it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

Belgium sand is also displacing local material in the manufacture of sodium silicate ('water glass'), having caused the closing down of operations in 1923 of the sand plant of the Philadelphia Quartz Company in Amador County.

Total Silica Production of California.

Total silica production in California since the inception of the industry, in 1899, is shown below, being mainly sand:

Year	Tons	Value	Year	Tons	Value
1899	3,000	$3,500	1913	18,618	$21,899
1900	2,200	2,200	1914	28,538	22,688
1901	5,000	16,250	1915	28,904	34,322
1902	4,500	12,225	1916	20,880	48,908
1903	7,725	7,525	1917	19,376	41,166
1904	10,004	12,276	1918	23,257	88,930
1905	9,257	8,121	1919	18,659	101,600
1906	9,750	13,375	1920	25,324	96,793
1907	11,065	8,178	1921	10,569	49,179
1908	9,255	22,045	1922	9,874	31,016
1909	12,259	25,517	1923	7,964	30,420
1910	19,224	18,265	1924	6,808	35,006
1911	8,620	8,672	1925	12,498	96,780
1912	13,075	15,404	Totals	356,203	$872,260

SILLIMANITE—ANDALUSITE—CYANITE GROUP.

Bibliography: State Mineralogist Report XX. Bulletins 67, 91. Dana's Mineralogy. U. S. Geol. Surv., Prof. Paper 110. Eng. & Min. Jour.-Press, Vol. 120, pp. 91–94, 1925. Amer. Mineralogist, June, 1924.

Sillimanite and andalusite are both aluminum silicates (Al_2SiO_5), having the same composition and formula, but with slightly different physical characteristics. Though both crystallize in the orthorhombic system, their crystal habits are different: Andalusite being usually in coarse prismatic forms, the prisms nearly square in shape; also occurs massive, imperfectly columnar, and sometimes radiated and granular. Sillimanite commonly occurs in long, slender crystals, not distinctly terminated; prismatic faces striated and rounded; often in close parallel groups, passing into fibrous and columnar massive forms, sometimes radiating. Colors are similar. Hardness, andalusite 7.5, sillimanite 6–7. Andalusite is slightly lighter in specific gravity.

A massive deposit of andalusite, found in Dry Creek Canyon in the White Mountains of the Inyo Range, in Mono County, is being mined by the Champion Porcelain Company of Detroit, Michigan. The material is shipped East and utilized in the manufacture of porcelain for automobile spark plugs and for other high-tension electric insulators.

Cyanite is also an aluminum silicate (Al_2SiO_5), of the same chemical composition as andalusite and sillimanite, but crystallizing in the triclinic system. Occurs usually in long-bladed crystals, rarely terminated; hardness 5-7.25; gravity 3.56-3.67 (being heavier than the other two); color, blue. A deposit of cyanite, apparently in quantity, is now being developed in Imperial County, near Ogilby, and small shipments have been made for experimental purposes.

Dumortierite, though differing somewhat in composition from the above, being a basic aluminum silicate ($4\ Al_2O_3.3\ SiO_2$), has proved similar in behavior in ceramic work so that it is now being mixed with andalusite for electrical porcelains. A deposit of this mineral in

Nevada is being mined for that purpose. Occurrences of massive dumortierite are known in Imperial County in this state and there may yet be some commercial possibilities for them.

SOAPSTONE and TALC.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII–XXII. Bulletins 38, 67, 91. U. S. Bur. of Mines, Bulletin 213. Rep. of Investigations, Serial No. 2253, May, 1921.

The total output of talc and soapstone in California in 1925 amounted to 15,465 tons valued at $239,084, compared with 16,179 tons valued at $242,770 in 1924. Nearly eighty per cent of the product was high-grade talc from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper, and rubber manufacture, and some in ceramics. The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

It is reported that California talc is steadily replacing imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of masssive sopastone from Virginia.

Composition and Varieties.

Talc is hydrous magnesium silicate with the chemical formula $H_2Mg_3(SiO_3)_4$. It is also called soapstone and steatite. The term 'talc' properly includes all forms of the pure mineral, whereas 'steatite' denotes particularly the massive, compact variety, and 'soapstone' the impure, massive forms containing as low as 50% of talc. When pure, talc is soft, having a hardness of 1, but impurities increase the hardness up to 3 or 4. The color varies from pure white and silvery white through gray, green, apple green, to dark green, also yellow, brown, and reddish when impure. It is commonly compact or massive, or in fine granular aggregates, and often in foliated plates or in fibrous aggregates.

Uses.

Although the uses of talc and soapstone are many and varied, some of them are not in general well known nor fully developed; and although few of their uses can justly be considered essential in the sense that no substitutes can be used, there are several which are of great importance. The widest use of talc is in the powdered form, and the value depends upon color (whiteness), uniformity, fineness of grain, freedom from grit, 'slip,' and sometimes freedom from lime. The white varieties, free from grit and iron, low in lime, ground to 200-mesh and finer, are largely used as a filler for paper, rubber and paint, and the very highest grade as toilet powder. Ground talc is also used in dressing and coating cloth, in making soap, rope, twine, pipe-covering compounds, heavy lubricants, and polishes. Ground talc and soapstone are used for foundry facings, either alone or mixed with graphite and a coarser grade is used in the manufacture of asphalt-coated roofing felts and papers, both as a filler and as a surfacing. Massive close-grained talc, free from iron and grit, is cut into blanks and baked, forming the material used for gas tips and electrical insulation, commonly known as 'lava.' Its hardness, its resistance to heat, acids and alkalies, and its great dielectric strength make it very useful for electric insulation, and no satisfactory substitute for it has been found.

Massive varieties of talc, pyrophyllite, and high grades of soapstone are cut into slate pencils and steel-workers' crayons. 'French chalk' or 'tailor's chalk' is a soft, massive talc. In China, Japan and India, massive talc (steatite) is carved into grotesque images and other forms, and is often sold as imitation jade. Soapstone is cut into slabs of 1 to 2 inches in thickness and sold as griddles, footwarmers, and fireless-cooker stones, or fabricated into laundry sinks and tubs, laboratory-table tops, hoods, tanks and sinks, electric switchboards, and for other uses in which the properties of resistance to heat, acids, and alkalies, and electricity are essential.

A detailed description of the classification and uses of talc and soapstone was given in the statistical report for 1922 (Bulletin 93) issued by the State Mining Bureau, copies of which are still available for distribution.

Imports.

Foreign importations of high-grade white talc suitable for the manufacture of toilet powder have come mainly from Canada, Italy and France. Foreign producers have the benefit of cheap labor, and a low tariff import duty. In addition to these disadvantages, California operators have to contend with transcontinental freight rates to the eastern manufacturing centers. In 1925 importations totaled 20,990 short tons valued at $449,338, compared with 18,199 tons valued at $356,629 in 1924, according to the United States Bureau of Foreign and Domestic Commerce.

Talc Production of California, by Years.

Production has been intermittent in the state since 1893, as shown in the following table:

Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1910	740	$7,260
1894			1911		
1895	25	375	1912	1,750	7,350
1896			1913	1,350	6,150
1897			1914	1,000	4,500
1898			1915	1,663	14,750
1899			1916	1,703	9,831
1900			1917	5,267	45,279
1901	10	119	1918	11,760	85,534
1902	14	288	1919	8,764	115,091
1903	219	10,124	1920	11,327	221,362
1904	228	2,315	1921	8,752	130,078
1905	300	3,000	1922	13,378	197,186
1906			1923	17,439	252,661
1907			1924	16,179	242,770
1908	3	48	1925	15,465	239,084
1909	33	280	Totals	117,769	$1,613,185

STRONTIUM.

Bibliography: Bulletins 67, 91. U. S. G. S., Bull. 540; 660-I.

There has been no production of strontium minerals in California since 1918, though in that year both celestite ($SrSO_4$), and the carbonate, strontianite ($SrCO_3$) were shipped. The first recorded commercial output of strontium minerals in California was in 1916. The occurrence of the carbonate is particularly interesting and valuable, as it appears to be the only considerable deposit of commercial importance so far opened up in the United States. Shipments reported as averaging 80% $SrCO_3$ have been made. The deposit is associated with deposits of barite, near Barstow, San Bernardino County. The carbonate has also been found in massive form near Shoshone, Inyo County. In addition to Imperial County, celestite is found near Calico and Ludlow, and in the Avawatz Mountains in San Bernardino County, but as yet undeveloped.

Production of strontium minerals in California, by years, has been as follows:

Year	Tons	Value
1916	57	$2,850
1917	3,050	37,000
1918	2,900	33,000
1919	----------	----------
Totals	6,007	$72,850

The principal use for strontium in the United States is in the form of the nitrate in the manufacture of red flares, or Costen and Bengal lights and fireworks. Previous to 1914, the nitrate was imported from Germany, England, and Sicily. In Germany and Russia, strontium in the form of the hydroxide is used in the manufacture of beet sugar. It is stated that strontia is more efficient and satisfactory in that process than lime, as it gives an additional recovery of 6% to 8%.

Of the two minerals, strontianite (carbonate) and celestite (sulphate), the carbonate is the more desirable as it is easier to convert to other salts; but it is scarcer. Celestite is found with limestone and sandstone and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.

SULPHUR.

Bibliography: State Mineralogist Reports IV, XIII, XIV. Bulletins 38, 67, 91.

In 1923-1924 there was a small production of sulphur, from a single property in Kern County. It was ground, and utilized as a fertilizer and in dusting for mildew. This is the first commercial output of native sulphur in California for many years although this mineral has been found to some extent in Colusa, Imperial, Inyo, Kern, Lake, Sonoma, Tehama, and Ventura counties.

Sulphur was produced at the famous Sulphur Bank mine in Lake County, during the years 1865-1868 (inc.), totaling 941 tons, valued at

$53,500; following which the property became more valuable for its quicksilver. The Elgin quicksilver mine, near Wilbur Springs, Colusa County, is a similar occurrence.

The principal sources in the United States are the stratified deposits in Louisiana and Texas, extraction being accomplished by a unique system of wells with steam pipes. It is stated that the three large companies operating there are capable of producing more than 1,000,000 tons annually in excess of our normal consumption in the United States, which averages about 600,000 tons. The mines at Freeport, Texas, are in a peculiarly favorable location in that they are practically at tidewater.

Formerly considerable sulphur was imported from Italy and from Japan; but the situation is now reversed, so that in 1925, a total of 629,401 long tons valued at $11,000,235 was exported from the United States, principally to Europe and Canada.

CHAPTER SIX.

SALINES.

Bibliography: State Mineralogist Reports III, XIV, XV, XVII-XXII (inc.). Bulletin 24. Spurr and Wormser, "Marketing of Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

Under this heading are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties. Except for a single year's absence, soda has had a continuous production since 1894. Potash, magnesium chloride and sulphate, and calcium chloride have been added to the commercial list in recent years, while the nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, and San Luis Obispo counties, and the waters of the Pacific Ocean.

The total value of this group shows a slight increase to $4,386,736 in 1925 over the 1924 figure of $4,374,192, as detailed in the following tabulation:

Substance	1924		1925		Increase+ Decrease— Value
	Tons	Value	Tons	Value	
Borates	52,070	$1,599,149	46,124	$1,526,938	$72,211—
Calcium chloride	*		*		* +
Magnesium salts	4,823	145,883	4,221	132,553	13,330—
Potash	33,107	747,407	36,355	829,770	82,363+
Salt	318,800	1,159,137	284,068	949,826	209,311—
Soda	32,536	711,796	48,625	947,649	235,853+
Unapportioned		[a]10,820			10,820—
Total value		$4,374,192		$4,386,736	
Net increase					$12,544+

*Under 'Unapportioned.'

[a] Includes calcium chloride, aluminum sulphate, glauber salt, potash alum.

BORATES.

Bibliography: State Mineralogist Reports III, X, XII-XV (inc.), XVII-XXII (inc.). Bulletins 24, 67, 91.

During 1925 there was produced in California a total of 79,865 tons of borate materials compared with 93,273 tons for the year 1924. The materials shipped in 1925 included crude and selected colemanite ore from Inyo and Kern counties varying from 19% to 30% anhydrous boric acid ('A.B.A.'), also crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40% A.B.A. This is approximately the average A.B.A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Recalculated as above, the 1925 production totals 46,124 tons valued at $1,526,938, a decrease from the similar figures for 1924 which were 52,070 tons and $1,599,149.

Colemanite is a calcium borate, and the material mined is shipped to seaboard chemical plants for refining. Refined 'borax' (sodium tetraborate) is used in making the enameled coating for cast-iron and steelware employed in plumbing fixtures, chemical equipment, and kitchen utensils. It is also a constituent of borosilicate glasses which are utilized in making lamp chimneys, baking dishes, and laboratory glassware. Other important uses of borax are in the manufacture of laundry and kitchen soaps, in starch, paper sizing, tanning, welding, and in the preparation of boric acid, which is employed as an antiseptic and in preserving meats.

Two new uses for borax have been recently reported, which give promise of becoming important factors in the industry. The first is in the preserving of citrus fruits by washing them in a solution of borax, which closes the pores of the skin. The application of this process is increasing in California and Florida. The second is as a preservative of wood, in addition to which borax, being non-inflammable, renders it fireproof.

Surprising as it may seem, the strike in Great Britain in the early months of 1926 had its reaction in places as remote and apparently so dissociated from British economic problems as the region of Death Valley, California. Though popularly known chiefly as a cleansing and preservative commodity, borax has wider and heavier commercial uses in the pottery and metal industries where it is employed as a flux. The suspension of these industries in England, therefore, even for a brief period, affected exports from California's borate mines.

Total Production of Borate Materials in California.

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake in Lake County was discovered in September of the same year by Dr. John A. Veach. This deposit was worked in 1864–1868, inclusive, and during that time produced 1,181,365 pounds of refined borax. The bulk of it was exported by sea, to New York. This was the first commercial output of this salt in the United States, and California is still today the leading American producer of borax, having been for many years the sole producer.

Production from the dry lake 'playa' deposits of Inyo and San Bernardino counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico, in San Bernardino County. These have since been largely worked out, and the output for a number of years has been coming from similar beds in Inyo and Los Angeles counties. In 1920 San Bernardino County again entered the field with shipments of such ore from near Daggett. The colemanite deposits of Ventura County are at present unworked, owing to lack of transportation facilities. Some production of colemanite is being made from deposits recently opened up in Clarke County, Nevada.

The total production of borate materials in California is shown in the following table:

Year	Tons	Value	Year	Tons	Value
1864	12	$9,478	1895	5,959	$595,900
1865	126	94,099	1896	6,754	675,400
1866	201	132,538	1897	8,000	1,080,000
1867	220	156,137	1898	8,300	1,153,000
1868	32	22,384	1899	20,357	1,139,882
1869	----------	----------	1900	25,837	1,013,251
1870	----------	----------	1901	22,221	982,380
1871	----------	----------	1902	[a]17,202	2,234,994
1872	140	89,600	1903	34,430	661,400
1873	515	255,440	1904	45,647	698,810
1874	915	259,427	1905	46,334	1,019,158
1875	1,168	289,080	1906	58,173	1,182,410
1876	1,437	312,537	1907	53,413	1,200,913
1877	993	193,705	1908	22,200	1,117,000
1878	373	66,257	1909	16,628	1,163,960
1879	364	65,443	1910	16,828	1,177,960
1880	609	149,245	1911	50,945	1,456,672
1881	690	189,750	1912	42,135	1,122,713
1882	732	201,300	1913	58,051	1,491,530
1883	900	265,500	1914	62,500	1,483,500
1884	1,019	198,705	1915	67,004	1,663,521
1885	942	155,430	1916	103,523	2,409,375
1886	1,285	173,475	1917	109,944	2,561,958
1887	1,015	116,689	1918	88,772	1,867,908
1888	1,405	196,636	1919	66,791	1,717,192
1889	965	145,473	1920	127,065	2,794,206
1890	3,201	480,152	1921	50,136	1,096,326
1891	4,267	640,000	1922	[b]39,087	1,068,025
1892	5,525	838,787	1923	62,667	1,893,798
1893	3,955	593,292	1924	52,070	1,599,149
1894	5,770	807,807	1925	46,124	1,526,938
			Totals	1,473,873	$49,947,597

[a] Refined borax. [b] Recalculated to 40% 'anhydrous boric acid' equivalent beginning with 1922

CALCIUM CHLORIDE.

Bibliography: U. S. Geol. Surv., Min. Res. 1919, Pt. II. Engineering and Contracting, Roads & Streets monthly issue, Feb. 6, 1924. 'How to Maintain Roads,' manual of instruction of Dow Chemical Company.

Calcium chloride is hygroscopic, that is, it has an affinity for water. This property is taken advantage of by utilizing this salt as a drying agent. It is also sprinkled on dirt roads and playgrounds to keep down dust by absorbing moisture. In refrigerating machinery for ice factories, meat-packing houses and cold-storage warehouses, a calcium-chloride solution is stated to have some advantages over salt brine. In fire buckets this solution has an advantage over pure water, in that it has a lower freezing point, does not corrode metal, and tends to keep the buckets full due to its absorbing moisture from the atmosphere. Powdered calcium chloride is used in drying gases, fruits and vegetables.

For dust prevention on roads, it is stated that the flake form of the chloride gives better results than the granulated. Immediately after spreading, the flake begins to absorb moisture from the air—"in fact, absorbs three times its weight in water, dissolves itself into the surface material of the road, remains there, holds the moisture and prevents dust.'' It is recommended that the first application in the spring should be made as soon as the roads are partly dried and the spring rains over, in order to prevent the accumulation of the first dust during the season. From 1 to 2 pounds of flake chloride are used per square yard according to the nature of the road surface. Ordinarily a second application, of from ½ to 1 pound per square yard, should follow in from four to six weeks depending upon conditions; and sometimes a light, third application may be necessary during a long, dry summer. The most satisfactory method for applying large quantities of flake calcium chloride is to use an agricultural lime or fertilizer spreader attached by a short tongue to the rear of a truck. Excellent results are reported with the following kinds of road surfaces: gravel, water-bound gravel, water-bound macadam, sand-clay, clay-sand, cinders, mine tailings. It can not be used to advantage on roads of heavy clay, oil-treated surfaces, heavy rolling sand, or the ordinary dirt road which is composed almost entirely of fine dead material. The last named should first have a resurfacing or application of gravel.

A very important and growing use for calcium chloride is its application to curing concrete pavements instead of the slower and more expensive earth and water-covering method. It is stated that one application of the flake chloride will absorb a sufficient amount of moisture from the air to keep the pavements wet continuously 24 hours per day when properly applied. As soon as the newly laid concrete has taken on enough set to permit an application without marring the surface, the chloride should be spread on at the rate of 2 to 2½ pounds per square yard, depending upon the dryness of the weather. It should be evenly spread. There is no need of applying an earth covering and hence no subsequent earth removal, and no extra water pumping, thereby eliminating these items of expense. Not only that, but experience has proved that the time of set for the concrete is shortened by use of the chloride, so that pavements so treated can be opened to traffic in one-half the time required if cured by ponding or by earth and water. In the case of patching broken pavements, if calcium chloride is mixed in with the concrete as laid, in proper proportions, and a further application spread on the finished surface, the patched pavement can be opened to traffic in 48 hours without injury to the concrete.

Californian Production.

Commercial production of calcium chloride in California was first reported to the State Mining Bureau in 1921, from two plants in San Bernardino County, being obtained as a by-product in the refining of salt from deposits in certain of the desert dry lakes. In 1922–1924, there was only a single operator, so that the annual details are concealed under the 'unapportioned' item.

Year	*Tons*	*Value*
1921	683	$22,980
1922 1923 *	1,204	26,580
1924 1925 *	10,988	328,876
Totals	12,875	$378,436

*Annual details concealed under 'Unapportioned.'

MAGNESIUM SALTS.

Bibliography: State Mineralogist Reports XX, XXI. Bulletin 91. 'Dictionary of Applied Chemistry,' by Thorpe. U. S. Geol. Surv., Min. Res. of U. S.

The production of magnesium chloride and sulphate in California during 1925 totaled 4221 tons valued at $132,553, a slight decrease both in quantity and value from the 1924 figures of 4,823 tons and $145,883. This was nearly all chloride, sold for use in magnesite stucco and cement mixtures (Sorel cement), also some for 'road liquor.' It was in part marketed in the liquid form testing 34°–36° Baumé, and in part as dry crystals, and was prepared from residual bitterns at salt plants in Alameda, Los Angeles, San Diego, and San Mateo counties. The sulphate marketed was utilized for medicinal and bath purposes.

With the use of magnesite cement and stucco coming more into prominence in building construction on the Pacific Coast, the demand for magnesium chloride is increasing here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

The average value reported for the chloride produced in California in 1925 was approximately $32 per ton, f.o.b. plant.

Total Production of Magnesium Salts in California.

Commercial production of magnesium chloride in California was begun in 1916 by some of the salt companies, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride. In addition, some magnesium sulphate, or 'epsom salts' is also made, annually, but in smaller amount.

The total production of magnesium salts in California, since the beginning of the industry here, is shown in the following tabulation:

Year	Tons	Value
1916	851	$6,407
1917	1,064	34,973
1918	1,008	29,955
1919	1,616	82,457
1920	3,150	107,787
1921	4,153	106,140
1922	3,036	89,788
1923	3,662	116,031
1924	4,823	145,883
1925	4,221	132,553
Totals	27,584	$851,974

NITRATES.

Bibliography: State Mineralogist Report XV. Bulletins 24, 67, 91. U. S. G. S., Press Bulletin No. 373, July, 1918.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. It is hoped that a closer search may some day be rewarded by workable discoveries. At present the principal commercial source of nitrates is the Chilean saltpeter (sodium nitrate) deposits in South America.

The fixation of atmospheric nitrogen electrically has been accomplished successfully in Germany and Scandinavia. The possibilities of cheap hydro-electric power in California make the subject one of interest to us, as we have also the natural raw materials and chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically.

POTASH.

Bibliography: State Mineralogist Reports XV, XVIII, XX, XXII. Bulletins 24, 67, 91. U. S. G. S., Min. Res. 1913, 1914, 1915. Senate Doc. No. 190, 62d Congress, 2d Session. Mining & Sci. Press, Vol. 112, p. 155; Vol. 114, p. 789. Eng. & Min. Jour.-Press, Vol. 117, p. 557, Apr. 5, 1924.

During 1925, a total of 36,355 tons of potash salts of all grades was produced in California valued at $829,770, compared with 33,107 tons and $747,407 in 1924. This was entirely of chloride, being mainly from Searles Lake brine, San Bernardino County, but in part from salt-works bitterns at plants in Alameda and San Mateo counties. The quality of the product varied from 45% to 61% equivalent K_2O content; and the material was sold principally for fertilizer manufacture.

Imports of crude potash minerals and salts into the United States in 1925, according to the U. S. Bureau of Foreign & Domestic Commerce, amounted to 820,637 long tons, valued at $13,050,908, compared with 632,019 tons and $10,440,244 in 1924. These materials consisted mainly of 'manure salts,' crude chloride (muriate), and sulphate, and kainite, all of which are admitted duty-free.

Quotations have recently ranged from $45 per ton, c.i.f., Atlantic and Gulf ports, for high-grade sulphate (90%–95%), to $34 per ton for muriate (80%–85%), and $18–$20 for manure salts (30%).

Other uses for potash salts, besides those noted above, are in the manufacture of the best liquid soap and some higher-grade cake soaps, of some finer grades of glass, and in matches. The chemical requirements include tanning, dyeing, metallurgy, electroplating, photography and medicine.

Total Production of Potash in California.

Potash production began commercially in California in 1914, with a small yield from kelp. Considerable time and money have been spent on research work incident to developing deposits of potash-bearing residues and brines in the old lake beds of the desert regions, and production there has been accomplished on a commercial scale at plants on Searles Lake, San Bernardino County. Some is also made annually from salt-works bitterns, and for a time there was some from Portland cement dust.

The annual amounts and value of these potash materials, since their beginning in California in 1914, are shown by the following table:

Year	Tons	Value
1914	10	$460
1915	1,076	19,391
1916	17,908	663,605
1917	129,022	4,202,889
1918	49,381	6,808,976
1919	28,118	2,415,963
1920	26,298	1,465,463
1921	14,806	390,210
1922	17,776	584,388
1923	29,597	709,836
1924	33,107	747,407
1925	36,355	829,770
Totals	383,454	$18,844,358

SALT.

Bibliography: State Mineralogist Reports II, XII–XV (inc.), XVII–XXI (inc.); Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 669. U. S. Bur. of Mines, Bull. 146.

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey, and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions, mainly in Kern and San Bernardino counties. A small amount of valuable medicinal salts is obtained by evaporation of the water of Mono Lake, Mono County.

Distribution of the 1925 salt production of California, by counties, was as follows:

Salt Production, by Counties, 1925.

County	*Tons*	*Value*
Alameda	180,712	$497,692
Kern	6,890	28,858
San Bernardino	28,319	101,085
San Mateo	31,325	155,925
Los Angeles, Modoc, Mono,[a] Monterey, San Diego*	36,822	166,266
Totals	284,068	$949,826

[a] Medicinal salts. *Combined to conceal output of a single operator in each.

The above returns show a decrease both in tonnage and value from the record figures of 1924, which were 318,800 tons and $1,159,137. Slightly lower market prices prevailed during 1925, as a result of price cutting by one or two of the operators. As in 1924, there were nine plants operating in Alameda County in 1925, but a total of only eleven in the other counties tabulated (a decrease of one).

Production of Salt in California, by Years.

Amount and value of annual production of salt in California from 1887 is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1907	88,063	$310,967
1888	30,800	92,400	1908	121,764	281,469
1889	21,000	63,000	1909	155,680	414,708
1890	8,729	57,085	1910	174,920	395,417
1891	20,094	90,303	1911	173,332	324,255
1892	23,570	104,788	1912	185,721	383,370
1893	50,500	213,000	1913	204,407	462,681
1894	49,131	140,087	1914	223,806	583,553
1895	53,031	150,576	1915	169,028	368,737
1896	64,743	153,244	1916	186,148	455,695
1897	67,851	157,520	1917	227,825	584,373
1898	93,421	170,855	1918	212,076	806,328
1899	82,654	149,588	1919	233,994	896,963
1900	89,338	204,754	1920	230,638	972,648
1901	126,218	366,376	1921	197,989	832,702
1902	115,208	205,876	1922	223,238	819,187
1903	102,895	211,365	1923	275,979	1,130,670
1904	95,968	187,300	1924	318,800	1,159,137
1905	77,118	141,925	1925	284,068	949,826
1906	101,650	213,228			
			Totals	5,189,395	$15,317,956

SODA.

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XX; Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 717.

The production of carbonates and sulphate of sodium in California in 1925 included: soda ash and bicarbonate from plants at Owens Lake, Inyo County; trona ('sesqui-carbonate,' a double salt of Na_2CO_3 and $NaHCO_3$) from Searles Lake, San Bernardino County; and salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County. The total amounted to 48,625 tons valued at $947,649, being an increase in both quantity and value compared with the 1924 figures of 32,536 tons and $711,796.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, and chemicals; the salt cake in paper making; and the trona for metallurgical purposes.

Sodium compounds to some extent replace potassium compounds, in glass and soap making, in photography, in match making, in tanning, and in the manufacture of cyanide for extracting gold and silver from their ores.

Soda Production of California, by Years.

The total output, showing amount and value of these materials in California since the inception of the statistical records of the State Mining Bureau, is given in the table which follows:

Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1911	9,023	$52,887
1895	1,900	47,500	1912	7,200	37,094
1896	3,000	65,000	1913	1,861	24,936
1897	5,000	110,000	1914	6,522	115,396
1898	7,000	154,000	1915	5,799	83,485
1899	10,000	250,000	1916	10,593	264,825
1900	1,000	50,000	1917	24,505	928,578
1901	8,000	400,000	1918	20,447	855,423
1902	7,000	50,000	1919	21,294	721,958
1903	18,000	27,000	1920	32,407	1,164,898
1904	12,000	18,000	1921	14,828	438,996
1905	15,000	22,500	1922	20,084	573,661
1906	12,000	18,000	1923	34,885	764,284
1907	----------	----------	1924	32,536	711,796
1908	9,600	14,400	1925	48,625	947,649
1909	7,712	11,593			
1910	8,125	11,862	Totals	417,476	$8,955,721

CHAPTER SEVEN

BY COUNTIES.

Introductory.

The State of California includes a total area of 158,360 square miles, of which 155,980 square miles are of land. The maximum width is 235 miles, the minimum 148 miles, and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into fifty-eight counties. The 1920 census figures show a total population for California of 3,437,709. A January, 1925, estimate based upon average daily attendance in elementary schools places the figure this year at approximately 5,000,000. Minerals of commercial value exist in every county, and during 1925 some active production was reported to the State Mining Bureau from all of the fifty-eight.

Rank of Counties in Mineral Yield, 1925.

Of the first ten counties, in point of total output for 1925, the first four, Los Angeles, Kern, Orange, Ventura, owe their position mainly to petroleum, as do also Fresno (sixth) and Santa Barbara (ninth). Los Angeles, due to its oil, leads all the others, being credited with 44% of the entire state's total for 1925, having passed Kern in 1923, which led for many years. San Bernardino (fifth) owes its place chiefly to cement, silver, potash, borax, mineral water, and tungsten; Riverside (seventh) to cement, stone, brick and tile; Plumas to copper; Shasta to copper, stone, and pyrite; Santa Cruz to cement. Twenty-six counties have each a total in excess of a million dollars for 1925. Cement is an important item in seven of these counties, gold in six, and magnesite in one. In point of variety and diversity, San Bernardino County led all the others in 1925, with a total of 20 different mineral products on its commercial list, followed by Los Angeles with 18; by Kern, San Diego and Riverside with 17 each; Inyo, 15; Shasta, 14; Butte, 12; Calaveras, Orange, Placer, 11 each; Amador, Fresno, Mono, Sacramento, San Mateo, Santa Barbara, Santa Clara, 10 each. The counties with their mineral resources, production for 1925, etc., are considered in detail in the following paragraphs.

County.	*Value.*
1. Los Angeles	$193,180,000
2. Kern	89,400,726
3. Orange	49,104,490
4. Ventura	17,853,540
5. San Bernardino	14,179,663
6. Fresno	9,264,996
7. Riverside	5,179,108
8. Plumas	4,401,508
9. Santa Barbara	4,338,431
10. Shasta	4,300,449
11. Santa Cruz	3,227,036
12. Alameda	2,916,506
13. Yuba	2,721,594
14. Solano	2,678,547
15. Amador	2,625,703
16. San Benito	2,617,396
17. Inyo	2,585,145
18. Contra Costa	2,544,179
19. Sacramento	2,504,405
20. Nevada	2,352,877
21. San Mateo	1,577,513
22. Calaveras	1,450,618
23. Sierra	1,386,301
24. Madera	1,377,458
25. Santa Clara	1,320,858
26. San Diego	1,129,757
27. San Joaquin	737,818
28. Humboldt	719,151
29. Mariposa	634,862
30. Tuolumne	567,248
31. Placer	$550,413
32. Butte	546,178
33. Trinity	502,289
34. Marin	434,802
35. Tulare	426,979
36. Stanislaus	415,466
37. El Dorado	352,828
38. Imperial	330,965
39. Monterey	277,721
40. Del Norte	270,582
41. Napa	229,172
42. Siskiyou	219,626
43. Mono	184,745
44. Sonoma	160,231
45. San Luis Obispo	136,477
46. San Francisco	131,158
47. Colusa	103,230
48. Glenn	92,288
49. Merced	80,262
50. Tehama	77,183
51. Lake	73,348
52. Yolo	23,060
53. Mendocino	16,533
54. Lassen	2,404
55. Modoc	2,400
56. Alpine	520
57. Kings	520
58. Sutter	397
Total value	$434,519,660

ALAMEDA.

Area: 843 square miles.
Population: 344,177 (1920 census).
Location: East side of San Francisco Bay.

Alameda County, while in no sense one of the 'mining counties,' comes twelfth on the list with a value of mineral products for 1925 of $2,916,506, an increase over the 1924 total, which was $2,634,645. The mineral resources of this county include asbestos, brick, chromite, clay, coal, limestone, magnesite, manganese, potash, pyrite, salt, soapstone, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$938,375
Clay (pottery)	9,300 tons	11,376
Salt	180,712 tons	497,692
Stone, miscellaneous	------	1,414,398
Other minerals*	------	54,665
Total value		$2,916,506

*Includes magnesium salts, potash, pyrites.

ALPINE.

Area: 776 square miles.
Population: 243 (1920 census).
Location: On eastern border of state, south of Lake Tahoe.

Alpine has at times in the past shown a small production mainly of gold and silver. For 1925 the total value was $520 and included gold, silver, and miscellaneous stone.

This county lies just south of Lake Tahoe, in the high Sierra Nevada. Transportation is by auto, wagon, or mule back, and facilities in general are lacking to promote development work.

The mineral resources of this section are varied and the country has not yet been thoroughly prospected. Occurrences of barium, copper, gold, gypsum, lead, limestone, pyrite, rose quartz, silver, tourmaline, and zinc have been noted here.

AMADOR.

Area: 601 square miles.
Population: 7793 (1920 census).
Location: East-central part of state—Mother Lode district.

The value of Amador County's mineral production decreased from $2,938,865 in 1924 to $2,625,703, placing it number fifteen on the list of counties in the state as regards total value of mineral substances marketed. The decrease was due mainly to gold.

Although having an output consisting of 10 different minerals, the leading product, gold, makes up approximately 89% of the entire total.

Amador at one time led the state in gold production, though exceeded in 1920–1923 by Yuba and Nevada counties, but in 1925 by Yuba County only.

The mineral resources of this county include asbestos, brick, chromite, clay, coal, copper, gold, limestone, quartz crystals, glass-sand, sandstone, silver, soapstone, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance.	*Amount.*	*Value.*
Clay (pottery)	63,889 tons	$95,946
Gold	-----	2,338,101
Silver	-----	16,123
Stone, miscellaneous	-----	31,100
Other minerals*	-----	11,003
Total value		$2,625,703

*Includes coal, copper, lead, marble.

BUTTE.

Area: 1722 square miles.
Population: 30,030 (1920 census).
Location: North-central portion of state.

Butte, thirty-second county in California in regard to the value of its mineral output, reported a commercial production of twelve mineral substances, having a total value of $546,178 as compared with $641,750 in 1924. As will be noted in the following tabulation, gold is by far the most important item. Butte stands seventh among the gold-producing counties of the state. Among the mineral resources of this section are asbestos, barytes, chromite, gems, gold, limestone, marble, mineral water, platinum group, silver, and miscellaneous stone.

Commercial value for 1925 was as follows:

Substance.	*Amount.*	*Value.*
Gold	----	$355,289
Mineral water	4,484 gals.	2,742
Platinum	56 fine oz.	9,177
Silver	----	4,354
Stone, miscellaneous	----	156,738
Other minerals*	----	17,878
Total value		$546,178

*Includes brick, copper, gems (diamonds), lead, natural gas, soapstone.

CALAVERAS.

Area: 1027 square miles.
Population: 6183 (1920 census).
Location: East-central portion of state—Mother Lode district.

Calaveras County reported production of 11 different minerals, valued at $1,450,618 during the year 1925 as compared with the 1924 output of $1,572,419. Copper, gold and stone are the chief mineral substances. For the current year 1926, cement has been added, as the new plant of the Calaveras Cement Company, near San Andreas is now in operation. In regard to total value of mineral output, Calaveras stands twenty-second among the counties of the state, for 1925, and fifth in gold.

The principal mineral resources developed and undeveloped are: Asbestos, chromite, clay, copper, fuller's earth, gold, limestone, marble, mineral paint, mineral water, platinum group, pyrite, quartz crystals, silver, soapstone, and miscellaneous stone.

Commercial output for 1925 was as follows:

Substance.	*Amount.*	*Value.*
Copper	4,906,650 lbs.	$696,744
Gold	--------	652,433
Silver	--------	8,324
Stone, miscellaneous	--------	78,506
Other minerals*	--------	14,611
Total value		$1,450,618

*Includes pottery clay, gems (quartz crystals), lead, mineral water, platinum.

COLUSA.

Area: 1140 square miles.
Population: 9920 (1920 census).
Location: Sacramento Valley.

Colusa County lies largely in the basin of the Sacramento Valley. Its western border, however, rises into the foothills of the Coast Range of mountains, and its mineral resources—largely undeveloped—include coal, chromite, copper, gypsum, manganese, mineral water, pyrite, quicksilver, sandstone, miscellaneous stone, sulphur, and in some places traces of gold and silver.

The value of the 1925 production was $103,230, an increase over 1924 figures of $77,267, giving it forty-seventh place, and was as follows:

Substance.	*Value.*
Unapportioned*	$103,230

*Includes mineral water, sandstone, miscellaneous stone.

CONTRA COSTA.

Area: 714 square miles.
Population: 53,889 (1920 census).
Location: East side of San Francisco Bay.

Contra Costa, like Alameda County, lies on the eastern shores of San Francisco Bay, and is not commonly considered among the mineral producing counties of the state. It stands eighteenth on the list in this respect, however, with an output valued at $2,544,179 for the calendar year 1925. Various structural materials make up the chief items, including brick, cement, limestone, and miscellaneous stone. Among the others are asbestos, clay, coal, gypsum, manganese, mineral water, and soapstone.

Commercial production for 1925 was as follows:

Substance.	*Value.*
Stone, miscellaneous	$708,159
Other minerals*	1,836,020
Total value	$2,544,179

*Includes clay (pottery) and clay products, cement, limestone, mineral water.

DEL NORTE.

Area: 1024 square miles.
Population: 2759 (1920 census).
Location: Extreme northwest corner of state.
Transportation: Motor, wagon and mule back; steamer from Crescent City.

Del Norte almost rivals Alpine County in regard to inaccessibility. Like the latter county also, given transportation and kindred facilities, this portion of the state presents a field for development along mining lines especially. Its chief mineral resources, largely untouched, are chromite, copper, gems, gold, iron, platinum group, silver, and miscellaneous stone.

The 1925 output was a decrease from the figure of $722,265 in 1924, the principal item of which is crushed rock used on highway construction, and rock used on the Crescent City harbor jetty.

Commercial production for 1925, giving it fortieth place, was as follows:

Substance	*Value*
Gold	$681
Silver	1
Stone, miscellaneous	269,650
Other minerals	250
Total value	$270,582

EL DORADO.

Area: 1753 square miles.
Population: 6426 (1920 census).
Location: East-central portion of the state, northernmost of the Mother Lode counties.

El Dorado County, which contains the locality where gold in California was first heralded to the world, comes thirty-seventh on the list of counties ranked according to the value of their total mineral production during the year 1925. In addition to the segregated figures here given, a large tonnage of limestone is annually shipped from El Dorado for use in cement manufacture, and whose value is included in the state total for cement. The decrease from the 1924 figure of $395,572 was due to limestone.

The mineral resources of this section, many of them undeveloped, include asbestos, barytes, chromite, clay, copper, gems, gold, iron, molybdenum, limestone, quartz crystals, quicksilver, slate soapstone, silver, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	------	$40,212
Limestone	228,293 tons	297,127
Silver	------	238
Stone, miscellaneous	------	10,305
Other minerals*	------	4,946
Total value		$352,828

*Includes lime and silica.

FRESNO.

Area: 5950 square miles.
Population: 128,779 (1920 census).
Location: South-central portion of state.

Fresno County, sixth in importance as a mineral producer among the counties of California, reported an output for 1925 of ten mineral substances, with a total value of $9,264,996, a decrease from the reported 1924 production, which was worth $12,547,798.

The bulk of the above is derived from the petroleum production of the Coalinga field, with miscellaneous stone also important.

The mineral resources of this county are many, and, aside from crude oil, are in the main not fully developed. They include asbestos, barytes, brick, chromite, copper, gems, gold, graphite, gypsum, magnesite, natural gas, petroleum, quicksilver, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	------	$25,056
Granite	------	63,580
Natural gas	1,515,889 M cu. ft.	116,711
Petroleum	7,773,665 bbls.	8,503,390
Silver	------	151
Stone, miscellaneous	------	457,307
Other minerals*	------	98,801
Total		$9,264,996

*Includes clay and clay products, mineral water.

GLENN.

Area: 1259 square miles.
Population: 11,853 (1920 census).
Location: West side of Sacramento Valley.

Glenn County, standing forty-eighth, owes its position among the mineral-producing counties of the state mainly to the presence of large deposits of sand and gravel which are annually worked, the product being used for railroad ballast, etc. In 1917 and 1918, chromite was also an important item. In the foothills in the western portion of the county, deposits of chromite, copper, manganese, sandstone, and soapstone have been found.

Commercial production for 1925 was as follows, being an increase from the $41,550 of the previous year:

Substance	*Value*
Stone, miscellaneous	$92,288

HUMBOLDT.

Area: 3634 square miles.
Population: 37,857 (1920 census).
Location: Northwestern portion of state, bordering on Pacific Ocean.

Humboldt County is almost entirely mountainous, transportation within its limits being very largely by auto and wagon road, and trail, and until recent years was reached from the outside world by steamer only. The county is rich in mineral resources, among which are brick, chromite, coal, clay, copper, gold, iron, mineral water, natural gas, petroleum, platinum, silver, and miscellaneous stone.

Nine mineral substances, as shown by the table given below, having a total value of $719,151, were produced in 1925, as compared with the 1924 output of $485,478, the increase being due to the large amount of rock being used in jetty construction at Humboldt Bay (Eureka Harbor). Humboldt ranks twenty-eighth among the counties of the state for the year.

Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$13,142
Silver	62
Stone, miscellaneous	699,740
Other minerals*	6,207
Total value	$719,151

*Includes brick, pottery clay, mineral water, natural gas, platinum.

IMPERIAL.

Area: 4089 square miles.
Population: 43,383 (1920 census).
Location: Extreme southeast corner of the state.

During 1925 Imperial County produced six mineral substances having a total value of $330,965, an increase over the 1924 output of $139,908. Its rank is thirty-eighth. This county contains deposits of cyanite, gold, gypsum, lead, manganese, marble, pumice, salt, silver, sodium, and strontium, largely undeveloped.

Commercial production for 1925 was as follows:

Substance	*Value*
Stone, miscellaneous	$148,942
Other minerals*	182,023
Total value	$330,965

*Includes brick, cyanite, gypsum, pumice.

INYO.

Area: 10,019 square miles.
Population: 7031 (1920 census).
Location: Lies on eastern border of state, north of San Bernardino County.

Inyo, the second largest county in the state, and containing less than one inhabitant per square mile, is extremely interesting from a mineralogical point of view. It is noted because of the fact that within its borders are located both the highest point, Mount Whitney (elevation 14,502 feet), and the lowest point, Death Valley (elevation 290 feet below sea level), in the United States. In the higher mountainous sections are found many vein-forming minerals, and in the lake beds of Death Valley saline deposits exist.

Inyo's mineral production during the year 1925 reached a value of $2,585,145, standing seventeenth among the counties of the state in this respect. Fifteen different mineral substances were produced. The 1924 value was $2,110,075, the increase being due mainly to lead, soda, and tungsten, in spite of a drop in borates. Its mineral resources include antimony, asbestos, barytes, borates, copper, dolomite, gems, gold, gypsum, lead, marble, soda, sulphur, talc, tungsten, and zinc.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Copper	73,003 lbs.	$10,367
Gold	------	43,774
Lead	6,307,105 lbs.	548,196
Silver	------	117,763
Talc	5,335 tons	89,134
Zinc	145,000 lbs.	11,020
Other minerals*	------	1,764,891
Total value		$2,585,145

*Includes borates, building stone (tuff), fuller's earth, graphite, limestone, pumice, soda (ash and bicarbonate), tungsten concentrates.

KERN.

Area: 8003 square miles.
Population: 54,843 (1920 census).
Location: South-central portion of state.

Kern County, because of its immensely productive oil fields, for many years stood preeminent among all counties of California in the value of its mineral output, the exact figures for 1925 being $89,400,726. Kern was surpassed by both Los Angeles and Orange counties in 1923, but by Los Angeles, only, in 1924-1925, for which petroleum is also responsible. The 1924 mineral output for this county was worth $74,164,451. The increase was due to the higher prices for crude oil of all grades. During 1925, seventeen different mineral substances were produced.

Among the mineral resources, developed and undeveloped, of this section are antimony, asphalt, borax, brick, clay, copper, fuller's earth, gems, gold, gypsum, iron, lead, limestone, magnesite, marble, mineral paint, natural gas, petroleum, potash, salt, silver, soapstone, soda, sulphur, and tungsten.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	-------	$135,545
Natural gas	45,649,845 M cu. ft.	2,290,608
Petroleum	58,852,742 bbls.	84,255,094
Salt	6,890 tons	28,858
Silver	-------	7,455
Stone, miscellaneous	-------	3,000
Other minerals*	-------	2,680,166
Total value		$89,400,726

*Includes antimony, borates, brick and clay.

KINGS.

Area: 1559 square miles.
Population: 22,031 (1920 census).
Location: South-central portion of the state.

Little development has taken place in Kings County along mineral lines to date. Deposits of fuller's earth, gypsum, mineral paint, natural gas, and quicksilver, of undetermined extent, have been found in the county. Some drilling for oil has been under way, but there has, as yet, been no commercial output recorded.

Tulare Lake is in Kings County, though now largely drained, and the land under cultivation.

In a tie for fifty-sixth place with Alpine County, commercial mineral production in this county for 1925 was as follows:

Substance	*Amount*	*Value*
Natural gas	740 M cu. ft.	$440
Other minerals	---	80
Total value		$520

LAKE.

Area: 1278 square miles.
Population: 5542 (1920 census).
Location: About fifty miles north of San Francisco Bay and the same distance inland from the Pacific Ocean.

On account of its topography and natural beauties, Lake County is sometimes referred to as the Switzerland of America. The mineral resources which exist here are many and varied, actual production being comparatively small, as shown by the table below, and in the past composed mainly of quicksilver and mineral water. Some of the leading minerals found in this section, in part as yet undeveloped, are borax, chromite, clay, copper, gems, gold, gypsum, mineral water, quicksilver, silver, and sulphur.

In fifty-first place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Mineral water	62,970 gals.	$57,793
Stone, miscellaneous	-----	15,300
Other minerals*	-----	255
Total value		$73,348

*Includes copper and natural gas.

LASSEN.

Area: 4531 square miles.
Population: 8507 (1920 census).
Location: Northeast portion of state.

Lassen County is one of the only partly developed sections of California. Since about 1912 a railroad traversing the county north and south has been in operation, thus affording opportunity for development along mineral and other lines.

Among the mineral resources of this county are copper, gems, gypsum, gold, silver, and sulphur. In the past, some gold had been produced, but not for some years, until 1921, when the yield again became important. In fifty-fourth place, commercial production for 1925 was as follows:

Substance	*Value*
Gold	[illegible]
Silver	24
Stone, miscellaneous	[illegible]
Total value	[illegible]

LOS ANGELES.

Area: 4067 square miles.
Population: 936,438 (1920 census).
Location: One of the southwestern coast counties.

Mineral production in Los Angeles County for the year 1925 amounted in value to $193,180,000 as compared with the 1924 output, worth $168,420,709. This accounts for 44% of the entire state's total for 1925, and ranks Los Angeles County first in the state as a mineral producer, having in 1924 passed Kern County which had been leading for several years. The advance in 1925 was due to higher petroleum prices, in spite of decreases by brick and natural gas.

Its output of brick and tile was over three million dollars, and that of petroleum amounted to over one hundred and seventy-three million dollars. Among the mineral resources may be noted asphalt, barytes, borax, brick, clay, fuller's earth, gems, gold, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, natural gas, petroleum, salt, glass-sand, sandstone, serpentine, silver, soapstone, and miscellaneous stone. Some potash has been obtained from kelp.

Commercial production for 1925, consisting of 18 substances, was as follows:

Substance	*Amount*	*Value*
Brick	196,955 M	$3,300,748
Building tile (hollow)	44.345 tons	426,178
Clay (pottery)	217,707 tons	106,817
Gold	------	409
Mineral water	3,811,270 gals.	336,038
Natural gas	98,226,700 M cu. ft.	8,704,894
Petroleum	121,214,551 bbls.	173,215,593
Silver	------	15,444
Stone, miscellaneous	------	6,978,605
Other minerals*	------	95,274
Total value		$193,180,000

*Includes copper, lead, limestone, magnesium chloride, salt, sandstone, zinc.

MADERA.

Area: 2112 square miles.
Population: 12,203 (1920 census).
Location: East-central portion of state.

Madera County produced five different mineral substances during the year 1925, having a total value of $1,377,458, as compared with the 1924 output worth $955,469, the increase being due to granite. This county contains deposits of copper, gold, granite, iron, lead, molybdenum, pumice, silver, and building stone.

In twenty-fourth place, commercial production for 1925 was as follows:

Substance	*Value*
Gold	$2,366
Granite	1,358,410
Silver	82
Stone, miscellaneous	16,600
Total value	$1,377,458

MARIN.

Area: 529 square miles.
Population: 27,342 (1920 census).
Location: Adjoins San Francisco on the north.

Mineral production in Marin County during 1925 amounted to $434,802, being a decrease from the 1924 figure of $527,231 due to crushed rock. This county is not especially prolific in minerals, although among its resources along these lines are brick, gems, manganese, mineral water, soapstone, and miscellaneous stone.

In thirty-fourth place, commercial production for 1925 was:

Substance	*Value*
Stone, miscellaneous	$244,602
Other minerals*	190,200
Total value	$434,802

*Includes brick, pottery clay, mineral water.

MARIPOSA.

Area: 1463 square miles.
Population: 2775 (1920 census).
Location: Most southerly of the Mother Lode counties. East-central portion of state.

Mariposa County is one of the distinctly 'mining' counties of the state, although it stands but twenty-ninth on the list of counties in regard to the value of its mineral output for 1925 with a total of $634,862, as compared with the 1924 figure of $234,707, the increase being due to stone and gold.

Its mineral resources are varied; among the more important items being barytes, copper, gems, gold, lead, marble, silver, slate, soapstone, and miscellaneous stone.

The Yosemite Valley is in Mariposa County.

Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$192,910
Silver	1,758
Stone, miscellaneous	436,794
Other minerals	3,500
Total value	$634,862

MENDOCINO.

Area: 3453 square miles.
Population: 24,116 (1920 census).
Location: Joins Humboldt County on the south and bounded by the Pacific Ocean on the west.

Mendocino's annual mineral production has usually been small, the 1925 output being valued at $16,533, ranking it fifty-third among the counties. That of 1924 was worth $60,768.

Deposits of in part undetermined value of asbestos, chromite, coal, copper, graphite, magnesite, and mineral water have been found, as well as traces of gold, platinum, and silver.

Commercial production for 1925 was as follows:

Substance	*Value*
Stone, miscellaneous	$11,603
Other minerals*	4,930
Total value	$16,533

*Includes brick, coal, natural gas.

MERCED.

Area: 1995 square miles.
Population: 24,579 (1920 census).
Location: About the geographical center of the state.

Merced County as a whole lies in the San Joaquin Valley and it figures as one of the lesser mineral producing counties of the state. The 1925 mineral output was valued at $80,262 compared with $87,603 in 1924, the decrease being due to clay products.

Gold, platinum, and silver were formerly obtained in important amounts by dredging, which ceased in this county in 1918, though a small yield from other sources still continues. Undeveloped deposits of antimony, magnesite, quicksilver, and limestone have been noted in this county in addition to the foregoing.

In forty-ninth place, commercial production during 1925 was as follows:

Substance	*Value*
Clay and clay products	$43,326
Gold	289
Silver	1
Stone, miscellaneous	36,646
Total value	$80,262

MODOC.

Area: 3823 square miles.
Population: 5425 (1920 census).
Location: The extreme northeast corner of the state.

Modoc County, like Lassen, has only in recent years had the benefit of communication with the outside world by rail. Among its known mineral resources are clay, coal, gold, iron, quicksilver, salt, and silver. In fifty-sixth place, commercial production for 1925 was as follows:

Substance	*Value*
Unapportioned*	$2,400

*Includes salt and miscellaneous stone.

MONO.

Area: 3030 square miles.
Population: 960 (1920 census).
Location: Is bordered by the State of Nevada on the east and is about in the central portion of the state measured on a north and south line.

Gold mining has been carried on in portions of Mono County for many years, although taken as a whole it lies in a somewhat inaccessible country so far as rail transportation is concerned. It is in the continuation of the highly mineralized belt which was noted in Inyo County and contains among other mineral resources barytes, clay, copper, gold, limestone, molybdenum, pumice, salt, silver, and travertine.

In forty-third place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Copper	1,020 lbs.	$145
Gold	------	5,503
Lead	22,488 lbs.	1,957
Silver	------	1,590
Stone, miscellaneous	------	29,250
Other minerals*	------	146,300
Total value		$184,745

*Includes onyx, pumice, travertine, salt, silica (stucco-sand) sillimanite-andalusite.

MONTEREY.

Area: 3330 square miles.
Population: 27,980 (1920 census).
Location: West-central portion of state, bordering on Pacific Ocean.

Monterey County produced nine mineral substances during the year 1925, having a total value of $277,721, as compared with the 1924 output worth $286,490, the decrease being due to miscellaneous stone. Its mineral resources include brick, clay, copper, coal, diatomaceous earth, dolomite, feldspar, fuller's earth, gold, gypsum, limestone, mineral water, petroleum, quicksilver, glass-sand, sandstone, silver, and miscellaneous stone.

In thirty-ninth place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Clay (pottery)	414 tons	$1,161
Gold	----	998
Silver	----	3
Stone, miscellaneous	----	209,423
Other minerals*	----	66,136
Total value		$277,721

*Includes diatomaceous earth, quicksilver, salt, shale building stone, silica (glass sand).

NAPA.

Area: 783 square miles.
Population: 20,678 (1920 census).
Location: Directly north of San Francisco Bay—one of the 'bay counties.'

Napa, because of its production of structural and industrial materials and mineral water, stands forty-first on the list of mineral-producing counties in California. Its mineral resources include chromite, copper, gypsum, magnesite, mineral water, quicksilver, sandstone, and miscellaneous stone. In the past this county has been one of the important producers of quicksilver.

In 1925 the value of the output decreased to $229,172 from the 1924 figure of $359,265.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	----	$195
Mineral water	63,836 gals.	44,251
Silver	----	1,420
Stone, miscellaneous	----	177,186
Other minerals	----	6,120
Total value		$229,172

NEVADA.

Area: 974 square miles.
Population: 10,860 (1920 census).
Location: North of Lake Tahoe, on the eastern border of the state.

Nevada, one of the mountain counties of California, for some years alternated with Amador in the gold lead, but both were passed by Yuba in 1918–1921, also 1923. In 1922 and 1924, Nevada led, but dropped to third place in 1925. Nevada County stands twentieth on the list in regard to value of its total mineral output with a figure of $2,352,877 as compared with the 1924 production worth $2,945,267. The decrease is due to gold.

While this county actually produces mainly gold and silver, its resources cover a wide scope, including antimony, asbestos, barytes, bismuth, chromite, clay, copper, gems, iron, lead, mineral paint, pyrite, soapstone, and tungsten.

Commercial production for 1925 was as follows:

Substance	Value
Gold	$2,305,607
Silver	32,155
Stone, miscellaneous	10,333
Other minerals*	4,782
Total value	$2,352,877

*Includes chromite, copper, granite, lead.

ORANGE.

Area: 795 square miles.
Population: 61,375 (1920 census).
Location: Southwestern portion of state, bordering Pacific Ocean.

Orange County is one of the many in California which on casual inspection appears to be anything but a mineral producing section. It stood for several years, however, as the second county in the state in regard to the total value of mineral output, on account of its highly productive oil fields. It was passed in 1922 by Los Angeles, the credit for which is also due to oil, and in turn Orange passed Kern County in 1923, but dropped back to third in 1924 and 1925.

This county shows an increase in 1925, with a total value of mineral products of $49,104,490, compared to the 1924 output, worth $40,481,210 due to petroleum. Orange passed Shasta County in 1917, which previously for a number of years had exceeded all other counties in California, except Kern.

Aside from the substances actually produced and noted in the table below, coal, gypsum, iron, infusorial earth, sandstone, and tourmaline have been found in Orange County.

Commercial production for 1925 was as follows:

Substance	Amount	Value
Brick	3,253 M	$39,445
Clay (pottery)	13,431 tons	42,562
Gold	------	52
Natural gas	26,324,364 M cu. ft.	2,324,014
Petroleum	32,734,420 bbls.	46,384,673
Silver	------	995
Stone, miscellaneous	------	307,112
Other minerals*	------	5,637
Total value		$49,104,490

*Includes copper, lead, zinc.

PLACER.

Area: 1395 square miles.
Population: 18,584 (1920 census).
Location: Eastern border of state directly west of Lake Tahoe.

While standing only thirty-first on the list of mineral producing counties, Placer contains a wide variety of mineral substances, some of which have not been commercially exploited. Its leading products include gold, chromite, granite, copper, and clay. Other mineral resources are asbestos, brick, coal, gems, iron, lead, limestone, magnesite, manganese, marble, quartz crystals, glass-sand, silver, and miscellaneous stone.

Commercial production for 1925 was as follows, compared to a total value of $492,180 for the preceding year:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$147,981
Clay (pottery)	102,598 tons	138,813
Gold	------	121.785
Granite	------	14,929
Silver	------	620
Stone, miscellaneous	------	117,990
Other minerals*	------	8,295
Total value		$550,413

*Includes chromite, copper, silica (quartz).

PLUMAS.

Area: 2594 square miles.
Population: 5681 (1920 census).
Location: Northeastern border of state, south of Lassen County.

A considerable portion of the area of Plumas County lies in the high mountains, and deposits of the metals, especially gold and copper, are found there. Mineral production for 1925 was valued at $4,406,508, the increase being due to copper and silver. This placed the county eleventh in rank. In 1919 Plumas passed Shasta in the copper lead, owing to the Shasta smelters being closed down, which position Plumas still retains.

Among its mineral resources are chromite, copper, gold, granite, iron, lead, limestone, manganese, molybdenum, platinum, silver, and zinc.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Copper	26,950,029 lbs.	$3,826,904
Gold	--------	249,540
Silver	--------	294,254
Other minerals*	--------	30,810
Total value		$4,401,508

*Includes chromite, granite, manganese ore, miscellaneous stone.

RIVERSIDE.

Area: 7240 square miles.
Population: 60,297 (1920 census).
Location: Southern portion of state.

Riverside is the fourth county in the state in size and the seventh in regard to the total value of mineral output for 1925. Within its borders are included mountain, desert, and agricultural land. Its mineral resources include metals, structural and industrial materials and salines, some of the more important being brick, cement, clay, coal, copper, feldspar, gems, gold, gypsum, iron, lead, limestone, manganese, magnesite, marble, mineral paint, mineral water, salt, soapstone, silver, miscellaneous stone and tin. In point of variety, Riverside County showed seventeen different minerals commercially produced in 1925. The increase in 1925 from the 1924 value of $5,508,244 was due to cement.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$533,650
Clay (pottery)	74,787 tons	155,315
Copper	23,134 lbs.	3,285
Feldspar	1,990 tons	16,090
Gold	------	3,687
Granite	------	32,234
Lead	135,872 lbs.	11,821
Silica (quartz)	8,121 tons	84,706
Silver	------	2,570
Stone, miscellaneous	------	542,020
Other minerals*	------	3,793,730
Total value		$5,179,108

*Includes cement, coal, gypsum, mineral water.

SACRAMENTO.

Area: 983 square miles.
Population: 90,978 (1920 census).
Location: North-central portion of state.

Sacramento stands nineteenth among the counties of the state as a mineral producer, the output, principally gold, for 1925, being valued at $2,504,405, as compared with the 1924 production, worth $2,196,210. In regard to gold output alone, this county ranks fifth, being exceeded only by Yuba, Nevada, Amador and Sierra counties, the Sacramento product coming from the dredges. Its mineral resources include brick, clay, gold, granite, natural gas, platinum, silver, and miscellaneous stone.

Substance	*Value*
Brick and hollow building tile	$354,078
Clay (pottery)	2,748
Gold	1,302,320
Granite	155,250
Silver	1,920
Stone, miscellaneous	590,359
Other minerals*	97,730
Total value	$2,504,405

*Includes natural gas and platinum.

SAN BENITO.

Area: 1392 square miles.
Population: 8995 (1920 census).
Location: West-central portion of state.

While sixteenth among the counties of the state in regard to value of total mineral production for 1925, San Benito has led for some years in one important branch of the mineral industry, namely, quicksilver. Cement is also an important item.

Its other mineral resources, many of them undeveloped, include antimony, asbestos, bituminous rock, chromite, coal, dolomite, gems, gypsum, limestone, magnesite, mineral water, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Quicksilver	6,085 flasks	$486,797
Stone, miscellaneous	------	351,363
Other minerals*	------	1,779,236
Total value		$2,617,396

*Includes asbestos, cement, dolomite, magnesite, mineral water.

SAN BERNARDINO.

Area: 20,157 square miles.
Population: 73,401 (1920 census).
Location: Southeastern portion of state.

San Bernardino, by far the largest county in the state in area, ranks fifth as regards the value of its mineral output for 1925 with a total of $14,179,663, as compared with the 1924 total of $12,642,431. The increase is due mainly to cement, but in part to borates, mineral water, and potash.

San Bernardino for several years (except 1918) has led all other counties in the state in point of variety of minerals, producing commercially during 1925 a total of 20 different substances. This county also ranks first as a silver producer in the state, from the mines of the Randsburg district. In fact, the California Rand mine, there, has been the largest single producer in the United States for several years past.

This county, consisting largely of mountain and desert country, is highly mineralized, the following being included among its resources: Asbestos, barytes, borax, brick, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre, potash, salt, soapstone, soda, miscellaneous stone, strontium, talc, tungsten, vanadium, and zinc.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Cement	5,079,281 bbls.	$8,828,044
Clay (pottery)	1,540 tons	11,000
Copper	6,249 lbs.	888
Gold	------	157,374
Lead	61,480 lbs.	5,349
Lime	17,495 tons	124,446
Limestone	13,239 tons	27,569
Salt	28,319 tons	101,085
Silver	------	1,378,392
Stone, miscellaneous	------	395,048
Other minerals*		3,150,468
Total value		$14,179,663

*Includes borates, calcium chloride, fuller's earth, mineral water, petroleum, potash, soda (trona), talc, tungsten concentrates.

SAN DIEGO.

Area: 4221 square miles.
Population: 112,248 (1920 census).
Location: Extreme southwest corner of state.

San Diego ranks twenty-sixth in the total value of its mineral output for the year, with 17 different commercial minerals. The value for 1925 equaled $1,129,757, as compared with the 1924 output worth $1,013,119.

In the production of gems, San Diego County has led the state. Aside from minerals commercially produced, as shown below, San Diego County contains occurrences of bismuth, lithia, marble, nickel, soapstone, and tin. Potash has been produced from kelp.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$119,165
Gems	------	9,413
Clay (pottery)	26,976 tons	66,427
Gold	------	5,134
Granite	------	108,703
Mineral water	81,374 gals.	21,137
Silver	------	58
Stone, miscellaneous	------	508,538
Other minerals*	------	291,182
Total value		$1,129,757

*Includes feldspar, fuller's earth, lime, magnesium chloride, salt, silica.

SAN FRANCISCO.

Area: 43 square miles.
Population: 506,676 (1920 census).

Surprising as it may appear at first glance, San Francisco County is listed among the mineral producing sections of the state, actual production consisting mainly of crushed rock, sand and gravel. Small quantities of various valuable mineral substances are found here, including cinnabar, gypsum, lignite, and magnesite, none, however, in paying quantities. Some pumice has been produced.

In forty-sixth place, commercial production for 1925 was as follows:

Substance	*Value*
Stone, miscellaneous	$131,158

SAN JOAQUIN.

Area: 1448 square miles.
Population: 79,905 (1920 census).
Location: Central portion of state.

San Joaquin County reported a mineral production for the year 1925 having a total value of $737,818, as compared with the 1924 output worth $602,500.

Comparatively few mineral substances are found here, the chief ones being brick, clay, manganese, natural gas, glass-sand, and miscellaneous stone. Gold, platinum, and silver have been obtained by dredging in the Mokelumne River, which forms the boundary between this county and Amador on the northeast.

In twenty-ninth place, commercial production for 1925 was as follows:

Substance	*Value*
Brick and hollow building tile	$472,983
Stone, miscellaneous	103,237
Other minerals	161,598
Total value	$737,818

SAN LUIS OBISPO.

Area: 3334 square miles.
Population: 21,893 (1920 census).
Location: Bordered by Kern County on the east and the Pacific Ocean on the west.

The total value of the mineral production of San Luis Obispo County in 1925 was $136,477, as compared with the 1924 output, worth $317,779, the decrease being due to miscellaneous stone and sodium sulphate. Among its mineral resources, both developed and undeveloped, are asphalt, bituminous rock, brick, chromite, coal, copper, diatomaceous earth, gypsum, iron, limestone, marble, mineral water, onyx, petroleum, quicksilver, soda, and miscellaneous stone.

In thirty-eighth place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Gold	------	$840
Petroleum	29,590 bbls.	32,164
Silver	------	7
Stone, miscellaneous	------	50,113
Other minerals*	------	53,353
Total values		$136,477

*Includes brick, chromite, mineral water, natural gas, quicksilver, sodium sulphate.

SAN MATEO.

Area: 447 square miles.
Population: 36,781 (1920 census).
Location: Peninsula, adjoined by San Francisco on the north.

San Mateo's most important mineral products are stone and salt, the last-named being derived by evaporation from the waters of San Francisco Bay. The total value of all mineral production during 1925 equaled $1,577,513, as compared with the 1924 figures of $302,171, the increase being due to the starting of operations by the new cement plant of the Pacific Portland Cement Company at Redwood City.

Small amounts of barytes, chromite, infusorial earth, and quicksilver have been noted in addition to the items of economic value given below. Bricks have also been produced commercially.

In twenty-first place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Salt	31,325 tons	$155,925
Stone, miscellaneous	------	90,757
Other minerals*	------	1,330,831
Total value		$1,577,513

*Includes cement, gems (jasper), magnesium chloride, natural gas, petroleum, potash.

SANTA BARBARA.

Area: 2740 square miles.
Population: 41,097 (1920 census).
Location: Southwestern portion of state, adjoining San Luis Obispo on the south.

Santa Barbara County owes its position of ninth in the state in regard to its mineral output to the presence of productive oil fields within its boundaries. The total value of its mineral production during the year 1925 was $4,338,431, as compared with the 1924 output of $5,159,740, and included ten different mineral substances.

Aside from the mineral substances listed below, Santa Barbara County contains asphalt, diatomaceous earth, gilsonite, gypsum, magnesite, and quicksilver in more or less abundance.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick	4,205 M	$56,781
Hollow building tile	1,864 tons	18,706
Clay (pottery)	2,390 tons	5,800
Natural gas	2,545,208 M cu. ft.	248,708
Petroleum	2,647,380 bbls.	2,419,705
Stone, miscellaneous	------	106,665
Other minerals*	------	1,482,066
Total value		$4,338,431

*Includes diatomaceous earth, mineral water, shale oil.

SANTA CLARA.

Area: 1328 square miles.

Population: 100,588 (1920 census).

Location: West-central portion of state.

Santa Clara County reported a mineral output for 1925 of $1,320,858, as compared with the 1924 figures of $1,150,401.

This county, lying largely in the Coast Range Mountains, contains a wide variety of mineral substances, including brick, chromite, clay, limestone, magnesite, manganese, mineral water, petroleum, quicksilver, soapstone, and miscellaneous stone.

In twenty-fifth place, commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Brick	24,250 M	$251,059
Clay (pottery)	1,516 tons	3,216
Petroleum	13,828 bbls.	22,594
Stone, miscellaneous	------	453,273
Other minerals*	------	590,718
Total value		$1,320,858

*Including limestone, magnesite, mineral water, natural gas, quicksilver.

SANTA CRUZ.

Area: 435 square miles.

Population: 26,269 (1920 census).

Location: Bordering Pacific Ocean, just south of San Mateo County.

The mineral output of Santa Cruz County, a portion of which is itemized below, amounted to a total value of $3,227,036, giving the county a standing of eleventh among all others in the state in this regard.

The decrease from the 1924 figure of $4,339,233 is due to cement.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Lime	16,534 tons	$224,724
Limestone	16,551 tons	33,102
Stone, miscellaneous	------	21,125
Other minerals*	------	2,948,085
Total value		$3,227,036

*Includes bituminous rock and cement.

SHASTA.

Area: 3858 square miles.
Population: 13,311 (1920 census).
Location: North-central portion of state.

Shasta County stood tenth in California among the mineral producing counties for 1925, with an output valued at $4,300,449, as compared with the 1924 production worth $4,754,664, the decrease being due to copper, and in part to gold and stone, though zinc advanced.

The marked decrease since 1918 is due to the falling off in the output of copper, the large plants of the Mammoth and Mountain copper companies being shut down. Not taking petroleum into account, Shasta for a number of years led all of the counties by a wide margin; but in 1919-1923 was passed by San Bernardino, Plumas, Yuba, Inyo, Sacramento, Nevada, and Amador, among the 'metal' counties, though by only San Bernardino and Plumas of that group in 1925.

Shasta's mineral resources include asbestos, barytes, brick, chromite, coal, copper, gold, iron, lead, lime, limestone, mineral water, molybdenum, pyrite, silver, soapstone, miscellaneous stone, and zinc.

Lassen Peak is located in southeastern Shasta County.

Commercial production for 1924 was as follows:

Substance	*Amount*	*Value*
Copper	14,565,967 lbs.	$2,068,367
Gold	------	235,013
Lead	647,886 lbs.	56,366
Limestone	24,395 tons	28,480
Platinum	8 fine oz.	725
Silver	------	208,818
Stone, miscellaneous	------	349,617
Zinc	11,090,430 lbs.	842,873
Other minerals	------	510,190
Total value		$4,300,449

*Includes chromite, diatomaceous earth, iron ore, pyrites, talc.

SIERRA.

Area: 923 square miles.
Population: 1783 (1920 census).
Location: Eastern border of state, just north of Nevada County.

Sierra County reported a mineral production of $1,386,301, mainly of gold and silver, during the year 1925, as compared with the 1924 output worth $812,476, the increase being due to gold. Considering gold output alone this county stands fourth; and as to total mineral yield twenty-third.

Aside from the metals itemized below, Sierra County contains deposits of asbestos, chromite, copper, iron, lead, platinum, serpentine, and talc.

Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$1,373,705
Silver	8,919
Stone, miscellaneous	3,677
Total value	$1,386,301

SISKIYOU.

Area: 6256 square miles.
Population: 18,545 (1920 census).
Location: Extreme north-central portion of state, next to Oregon boundary.

Siskiyou, fifth county in California in regard to size, located in a highly mineralized and mountainous country, ranks forty-fourth in regard to the value of its mineral output for 1924.

Although this county is traversed by a transcontinental railroad in a north and south line, the mineral-bearing sections are almost without exception far from transportation and other facilities. A large part of the county is accessible by trail only. Future development and exploitation will increase the productiveness of this part of the state to a considerable degree.

Mount Shasta is located in Siskiyou County.

Among Siskiyou's mineral resources are chromite, clay, coal, copper, gems, gold, lead, limestone, manganese, marble, mineral water, pumice, quicksilver, sandstone, silver, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$180,120
Lime and limestone	3,535
Silver	831
Stone, miscellaneous	23,800
Other minerals*	11,340
Total value	$219,626

*Includes mineral water, platinum, sandstone.

SOLANO.

Area: 822 square miles.
Population: 40,602 (1920 census).
Location: Touching San Francisco Bay on the northeast.

Solano, while mostly valley land, produced mineral substances during the year 1925 to the total value of $2,678,547, ranking fourteenth among the counties of the state, the decrease from the 1924 figures of $3,089,475 being due to cement.

Among her mineral resources are brick, cement, clay, fuller's earth, limestone, mineral water, natural gas, onyx, quicksilver, salt and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Value*
Stone, miscellaneous	$145,484
Other minerals*	2,533,063
Total value	$2,678,547

*Includes cement, mineral water, onyx, travertine.

SONOMA.

Area: 1577 square miles:
Population: 51,990 (1920 census).
Location: South of Mendocino County, bordering on the Pacific Ocean.

Sonoma ranked forty-fourth among the counties of California during the year 1925, with a mineral production of $160,231, as compared with its 1924 output of $172,051. More paving blocks have been turned out here than in any other section of the state, but this industry has now ceased, owing to the construction of smooth-surface pavements both in the cities and on the highways.

Among Sonoma's mineral resources are brick, chromite, clay, copper, graphite, infusorial earth, magnesite, manganese, marble, mineral paint, mineral water, quicksilver, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Mineral water	19,963 gals.	$6,619
Quicksilver	351 flasks	29,134
Stone, miscellaneous	------	119,546
Other minerals*	------	2,200
Total value		$160,231

*Includes pottery clay, building stone (tuff), manganese ore.

STANISLAUS.

Area: 1450 square miles.
Population: 43,557 (1920 census).
Location: Center of state, bounded on south by Merced County.

Gold has usually been the chief mineral product of Stanislaus County, but it was exceeded in 1918–1919 by manganese, and in 1921–1923 and 1925, by miscellaneous stone. Brick, clay, gypsum, mineral paint, quicksilver, and silver are found here to some extent as well. This county for 1925 ranks thirty-sixth in the state in regard to value of minerals, with an output of $415,466, as compared with $345,138 in 1924, the increase being due to miscellaneous stone, though there was a decrease in gold yield. Gold, platinum, and silver are obtained mainly by dredging.

Commercial production for 1924 was as follows:

Substance	*Value*
Gold	$171,742
Silver	694
Stone, miscellaneous	221,256
Other minerals*	21,774
Total value	$415,466

*Includes magnesite, manganese ore, mineral paint, platinum.

SUTTER.

Area: 608 square miles.
Population: 10,115 (1920 census).
Location: Bounded by Butte County on the north and Sacramento on the south.

Sutter is one of only two counties in the state which for a number of years reported no commercial output of some kind of mineral substance. In 1917 some crushed rock was taken out, from the Marysville Buttes, also in 1925. There has been some utilization of natural gas. The 1925 mineral yield was valued at $397, being concealed under 'unapportioned.' Both clay and coal exist here, but deposits of neither mineral have been placed on a productive basis.

TEHAMA.

Area: 2893 square miles.
Population: 12,882 (1920 census).
Location: North-central portion of the state, bounded on the north by Shasta.

Tehama stands fiftieth among the mineral producing counties of the state for 1925 when its output was valued at $77,183, as compared with the 1924 yield worth $34,454, the increase being due to stone.

Among its mineral resources are listed brick, chromite, copper, gold, manganese, marble, mineral water, salt, and miscellaneous stone.

The 1925 yield was distributed as follows:

Substance	*Value*
Unapportioned*	$77,183

*Includes brick and miscellaneous stone.

TRINITY.

Area: 3166 square miles.
Population: 2551 (1920 census).
Location: Northwestern portion of state.

Trinity, like its neighbor, Siskiyou County, requires transportation facilities to further the development of its many and varied mineral resources. Deposits of asbestos, barytes, chromite, copper, gold, mineral water, platinum, quicksilver, silver, and building stone are known here, but with the exception of gold, chromite, copper, quicksilver, and platinum, very little active production of these mineral substances has been made as yet. The 1925 output of $502,289 shows a decrease from the 1924 figure of $509,344, due to copper, giving the county rank of thirty-third for the year.

Substance	*Amount*	*Value*
Copper	439,766 lbs.	$62,447
Gold	------	424,037
Platinum	26 fine oz.	3,081
Silver	------	7,724
Stone, miscellaneous	------	5,000
Total value		$502,289

TULARE.

Area: 4856 square miles.
Population: 59,031 (1920 census).
Location: Bounded by Inyo on the east, Kern on the south, Fresno on the north.

Tulare stands thirty-fifth on the list of mineral producing counties, the decrease from the 1924 value being due mainly to magnesite.

This county's mineral resources, among others, are brick, clay, copper, feldspar, graphite, gems, limestone, magnesite, marble, quartz, glass-sand, soapstone, miscellaneous stone, and zinc. Tulare for a number of years led the state in magnesite output, except in 1918 when it was passed by Napa County, and in 1921-1925 by Santa Clara.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Granite	------	$62,260
Limestone	13,300 tons	43,900
Magnesite	18,150 tons	245,557
Natural gas	250 M cu. ft.	175
Stone, miscellaneous	------	47,176
Other minerals*	------	27,911
Total value		$426,979

*Includes brick and lime.

TUOLUMNE.

Area: 2190 square miles.
Population: 7768 (1920 census).
Location: East-central portion of state—Mother Lode District.

Tuolumne ranks thirtieth among counties of the state relative to its total value of mineral output for 1925. This county ranks first as a producer of marble in the state. The decrease in the year's valuation to $567,248 for 1925 from the 1924 figure of $629,156 was due mainly to gold.

Chromite, clay, copper, gold, lead, limestone, marble, mineral paint, platinum, soapstone, silver, and miscellaneous stone are among its mineral resources.

Commercial production for 1925 was as follows:

Substance	*Value*
Gold	$155,592
Lime and limestone	268,000
Silver	614
Stone, miscellaneous	29,751
Other minerals	113,305
Total value	$567,248

*Includes dolomite, granite, marble.

VENTURA.

Area: 1878 square miles.
Population: 28,724 (1920 census).
Location: Southwestern portion of state, bordering on Pacific Ocean.

Ventura is the fourth county in the state in respect to the value of its mineral production for 1925, the exact figure being $17,853,540, as compared with the output for 1924 worth $6,089,394, the increase being due to petroleum and natural gas.

The highest gravity petroleum produced in the state is found here.

Among its other mineral resources are asphalt, borax, brick, clay, mineral water, natural gas, sandstone, and miscellaneous stone.

Commercial production for 1925 was as follows:

Substance	*Amount*	*Value*
Natural gas	20,144,646 M cu. ft.	$1,953,163
Petroleum	9,221,846 bbls.	15,769,357
Stone, miscellaneous	-------	131,020
Total value		$17,853,540

YOLO.

Area: 1014 square miles.
Population: 17,105 (1920 census).
Location: Sacramento Valley, bounded by Sutter on the east and Colusa on the north.

The mineral production from Yolo County during the year 1925 consisted entirely of miscellaneous stone, valued at $23,060, ranking it in fifty-second place. Deposits of undetermined value of iron and sandstone have been discovered within the confines of this county. Quicksilver has also been produced.

YUBA

Area: 639 square miles.
Population: 10,375 (1920 census).
Location: Lies west of Sierra and Nevada counties; south of Plumas:

Yuba is thirteenth of the mineral producing counties of the state, and first in regard to gold output for 1925, having passed Nevada and Amador counties in that metal. Iron and clay deposits have been reported in this county aside from the following commercial production shown for the year 1925. The increase over the 1924 figure of $2,190,181 was due mainly to gold obtained by the dredgers, which also yield silver and platinum. The 1921 dredge yield of gold was a record for the county.

The 1925 production of Yuba County was distributed as follows:

Substance	*Value*
Gold	$2,570,630
Silver	6,400
Stone, miscellaneous	137,288
Other minerals*	7,276
Total value	$2,721,594

*Includes natural gas and platinum.

APPENDIX.

MINING BUREAU ACT.

Chapter 679.

[Stats. 1913.]

An act establishing a state mining bureau, creating the office of state mineralogist, fixing his salary and prescribing his powers and duties; providing for the employment of officers and employees of said bureau, making it the duty of persons in charge of mines, mining operations and quarries to make certain reports, providing for the investigation of mining operations, dealings and transactions and the prosecution for defrauding, swindling and cheating therein, creating a state mining bureau fund for the purpose of carrying out the provisions of this act and repealing an act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all acts amendatory thereof and supplemental thereto or in conflict herewith.

[Approved June 16, 1913. In effect August 10, 1913.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby created and established a state mining bureau. The chief officer of such bureau shall be the state mineralogist, which office is hereby created.

SEC. 2. It shall be the duty of the governor of the State of California and he is hereby empowered to appoint a citizen and resident of this state, having a practical and scientific knowledge of mining, to the office of state mineralogist. Said state mineralogist shall hold his office at the pleasure of the governor. He shall be a civil executive officer. He shall take and subscribe the same oath of office as other state officers. He shall receive for his services a salary of three hundred dollars ($300) per month, to be paid at the same time and in the same manner as the salaries of other state officers. He shall also receive his necessary traveling expenses when traveling on the business of his office. He shall give bond for the faithful performance of his duties in the sum of ten thousand dollars ($10,000), said bond to be approved by the governor of the State of California.

SEC. 3. Said state mineralogist shall employ competent geologists, field assistants, qualified specialists and office employees when necessary in the execution of his plans and operations of the bureau, and fix their compensation. The said employees shall be allowed their necessary traveling expenses when traveling on the business of said department and shall hold office at the pleasure of said state mineralogist.

SEC. 4. It shall be the duty of said state mineralogist to make, facilitate, and encourage, special studies of the mineral resources and mineral industries of the state. It shall be his duty: to collect statistics concerning the occurrence and production of the economically important minerals and the methods pursued in making their valuable constituents available for commercial use; to make a collection of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collection constituting the museum of the state mining bureau; to provide a library of books, reports, drawings, bearing upon the mineral industries, and sciences of mineralogy and geology, and arts of mining and metallurgy, such library constituting the library of the state mining bureau; to make a collection of models, drawings and descriptions of the mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections and library as to make them available for reference and examination, and open to public inspection at reasonable hours; to maintain, in effect, a bureau of information concerning the mineral industries of this state, to consist of such collections and library, and to arrange, classify, catalogue, and index the data therein contained, in a manner to make the information available to those desiring it; to issue from time to time such bulletins as he may deem advisable concerning the statistics and technology of the mineral industries of this state.

SEC. 5. It is hereby made the duty of the owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character, within the state, to forward to the state mineralogist, upon his request, at his office not later than the thirtieth day of June, in each year, a detailed report upon forms which will be furnished showing the character of the mine, the number of men then employed, the method of working such mine and the general condition thereof, the total mineral production for the past year, and such owner, lessor, lessee, agent, manager or other person in charge of any mine within the state must furnish whatever information relative to such mine as the state mineralogist may from time to time require for the proper discharge of his official duties. Any owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character within the state, who fails to comply with the above provisions shall be deemed guilty of a misdemeanor.*

SEC. 6. The state mineralogist now performing the duties of the office of state mineralogist shall perform the duties of the office of state mineralogist as in this act provided until the appointment and qualification of his successor as in this act provided.

SEC. 7. The said state mineralogist shall take possession, charge and control of the offices now occupied and used by the board of trustees and state mineralogist and the museum, library and laboratory of the mining bureau located in San Francisco as provided for by a certain act of the legislature approved March 23, 1893, and hereafter referred to in section fourteen hereof, and shall maintain such offices, museum, library and laboratory for the purposes provided in this act.

SEC. 8. Said state mineralogist or qualified assistant shall have full power and authority at any time to enter or examine any and all mines, quarries, wells, mills, reduction works, refining works and other mineral properties or working plants in this state in order to gather data to comply with the provisions of this act.

SEC. 9. The state mineralogist shall make a biennial report to the governor on or before the fifteenth day of September next preceding the regular session of the legislature.

SEC. 10. All moneys received by the state mining bureau or any officer thereof (except such as may be paid to them by the state for disbursement) shall be receipted for by the state mineralogist or other officer authorized by him to act in his place and at least once a month accounted for by him to the state controller and paid into the state treasury to the credit of a fund which is hereby created and designated "state mining bureau fund." All moneys now in the possession of the state mining bureau or any officer thereof received from any source whatsoever, shall be immediately paid over to the state mineralogist and by him accounted for to the controller and paid into the state treasury to the credit of said fund. Said fund shall be used and is hereby appropriated for the use of said bureau in carrying out the purposes of this act.

SEC. 11. The said state mineralogist is hereby authorized and empowered to receive on behalf of this state, for the use and benefit of the state mining bureau, gifts, bequests, devises and legacies of real or other property and to use the same in accordance with the wishes of the donors, and if no instructions are given by said donors, to manage, use, and dispose of the gifts and bequests and legacies for the best interests of said state mining bureau and in such manner as he may deem proper.

SEC. 12. The state mineralogist may, whenever he deems it advisable, prepare a special collection of ores and minerals of California to be sent to or used at any world's fair or exposition in order to display the mineral wealth of the state.

SEC. 13. The state mineralogist is hereby empowered to fix a price upon and to dispose of to the public, at such price, any and all publications of the state mining bureau, including reports, bulletins, maps, registers or other publications, such price shall approximate the cost of publication and distribution. Any and all sums derived from such disposition, or from gifts or bequests made, as hereinbefore provided must be accounted for by said state mineralogist and turned over to the state treasurer to be credited to the mining bureau fund as provided for in section ten. He is also empowered to furnish without cost to public libraries the publications of the bureau and to exchange publications with other geological surveys and scientific societies, etc.

---

*Sec. 19 of the Penal Code of California provides: "Except in cases where a different punishment is prescribed by this code, every offense declared to be a misdemeanor is punishable by imprisonment in a county jail not exceeding six months, or by a fine not exceeding five hundred dollars, or by both."

SEC. 14. The state mineralogist provided for by this act shall be the successor in interest of the board of trustees of the state mining bureau, and the state mineralogist, under and by virtue of that certain act, entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management, and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all books, papers, documents, personal property, records, and property of every kind and description obtained or possessed, or held or controlled by the said board of trustees of the said state mining bureau, and the state mineralogist, and the clerks and employees thereof, under the provisions of said act of March 23, 1893, or any act supplemental thereto or amendatory thereof, shall immediately be turned over and delivered to the said state mineralogist herein provided for, who shall have charge and control thereof.

SEC. 15. That certain act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, and to provide for the appointment, duties and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction, and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, together with all acts amendatory thereof and supplemental thereto and all acts in conflict herewith are hereby repealed.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper	----
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz counties	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial counties	.25
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1925	Free
January, February, March, April, May, June, July, 1926	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston. 85 pp., 46 illustrations	$0.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896. 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899. 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps	.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903. 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905. 168 pp., 54 illustrations	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	$0.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted	2.50
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring, 1918. 248 pp., 51 illustrations, 5 maps, paper	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley, 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth	1.00
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916–1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917–1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	----
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth	1.00

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.	Price
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	$1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley, 1923, 188 pp., paper	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley, 1924, 162 pp., paper	Free
Bulletin No. 95. Geology and Ore Deposits of the Randsburg Quadrangle, by Carlton D. Hulin, 1925. 152 pp., 49 photographs, 13 line cuts, 1 colored geologic map, cloth	2.00
Bulletin No. 96. California Mineral Production for 1924, by Walter W. Bradley, 1925. 173 pp., paper	Free
Bulletin No. 97, California Mineral Production for 1925, by Walter W. Bradley, 1926, 172 pp., paper	Free

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	Free
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

	Price
**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County	$0.25
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County	.25
Register of Oil Wells, with Map, Los Angeles City	.35

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California, Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted	.50
**Unmounted	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	----
**Map of Trinity County	----
**Map of Tuolumne County	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

	Price
Map No. 1—Sargent, Santa Clara County	$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emido and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	1.00
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

INDEX.

Page
Alameda County 129
Alpine County 129
Aluminum 36
Amador County 129
Amblygonite 111
American Bureau of Metal Statistics, Chart 36
American Petroleum Institute, cited 21
Andalusite 115
Antimony 36
  native 37
  total production 37
Appendix 154
Aquamarine 101
Architectural terra cotta 96
Arrowhead Hot Springs, radioactivity at 110
Arsenic 37
Art pottery 96
Asbestos 91
  San Benito Asbestos Co. 91
  prices, Canadian asbestos 92
Asphalt 93

Bancroft, H. H., cited 45
Barytes 93
  total production 94
Ballast 88
Bauxite 36
Benitoite 100, 101
Bentonite 100
Beryl 38, 101
Beryllium 38
Bismuth 38
Bisque ware 96
Bituminous rock 63
  total production 64
Borates 120
  production, 1864-1925 122
Bowles, O., cited 82
Bradley, W. W., cited 25
Brown, C. C., cited 17
  J. R., cited 42
Brick 64–67
  production of various kinds 65
  total production, 1893–1925 67
Building stone. (*See* Granite, Marble, Sandstone, etc.)
Bulletins, list of 159
Bush, R. D., cited 21, 27
Butte County 130

Cadmium 39
Calaveras County 130
  Cement Co. 68
Calcium chloride 122
  use on roads 123
California, area of 128
  map of, showing approximate location of oil fields 27
  Zinc Co. 61
Californite 101
Casing-head gas 19
Celestite 96
Cement 67, 96
  total production 68
Champion Porcelain Co. 115
Chart, California, showing location of oil fields and districts 27
  mineral production, annual value and increase 14
  natural gas, casing-head 18
    production and utilization 18
  non-ferrous metals, current trend of world production 36
  prices, asbestos, Canadian 92
    copper, electrolytic 40
    lead, common 48
    silver, bar, bullion 56
    zinc, slab 60
Chemical stoneware 96
Chimney pipe 96
Chinaware 96
Chipman Chemical Co., cited 37

PAGE

Chromite 68
  concentration of 69
  imports of 69
  occurrence of 69
  total production 70
Chrysoprase 102
Clay—pottery 94
  production, 1887–1925 96
  products 96
  uses of, other than for pottery 94
Coal 15
  gas from 15
  total production of 16
Cobalt 39
Colemanite 121
Collom, R. E., cited 25
Colusa County 131
Concentrating Plant California Zinc Co. 61
Concentration of chromite 69
Concrete 88
Conduit 96
Contra Costa County 131
Copper 40
  chart, trend of world production 35
    electrolytic copper prices 40
  production, 1882–1925 42
  stocks of, in United States 42
  United States production of 41
'Cornish' or 'Cornwall' stone 95
Cost data on oil operations 32
Counties, mineral production of 128
Crushed rock 62, 86
Cryolite 36
Cyanite 115
Curbing 72

Del Norte County 131
Diamonds 101
Diatomaceous earth 105
Dividends by oil companies 31
Dolomite 96
  total production 97
Dolomitic marble 88
Don Manuel Castanares, cited 45
Drain tile 96
Dredge production of platinum 51
Dredging, gold 44
Dumortierite 115

El Dorado County 132
  roofing of slate on residence 82
Electric smelting of ferro alloys 47
Eng. and Min. Jour.-Press, cited 40, 56, 60, 100

Faience tile 96
Feldspar 97
  total production 98
Ferberite 59
Ferguson blocks 65
Ferro-chrome by electric furnace 47
Ferro-manganese 47
  by electric furnace 47
Ferro-tungsten 59
Filter sand 86
Fire brick 65
  clay 96
Flue linings 96
Fluorspar 98
Fresno County 132
Fuels 15–33
Fuller's earth 99
  total production 100

Garnets 101
Gas (*See* Natural Gas)
Gasoline from natural gas 19
Gavin, M. J., cited 113
Gems 100
  total production 102
  varieties 101
Geysers, California, radioactivity at 110
Glass sand 114
Glenn County 133
Gold 43
  production by counties, 1925 44
  total production 46
Goodyear, W. A., cited 16

PAGE

- Gould, H., cited 54
- Granite 70
  - production, 1887–1925 73
  - Rock Co. plant 85
  - varieties of, in California 71
- Granules for roofing and stucco 88
- Graphite 102
  - total production 103
- Gravel 85
- Greenstone granules 88
- Grinding mill pebbles 84
- Gypsum 103
  - deposit, Pacific Portland Cement Co. 104
  - total production 105
  - uses 105

- Hanks, Henry, cited 23
- High-speed steels 59
- Hill, J. M., cited 44, 52, 56, 74
- Hittell, T. H., cited 45
- Hollow building tile or blocks 64
- Hübernite 58
- Humboldt County 133
- Hyacinth 101
- Hydrargillite 35
- Hydrocarbons 15

- Imperial County 134
- Industrial materials 90–119
- Infusorial earth 105
  - total production 106
- Inyo County 134
- Iridium 51
- Iron ore 34, 47
  - electric smelting of 47
  - total production 47

- Jade 101
- Jasper 101
  - roofing granules 88
- Jewelers' materials (*See* Gems)

- Kaolin 95
- Kern County 17, 135
- Kieselguhr 106
- Kings County 135
- Kunzite 101

- Lake County 136
- Lassen County 136
- Lassen Peak 148
- Lawver, A. M., cited 57
- Lead 47
  - chart, prices, common 48
    - trend of world production 35
  - production, 1887-1925 49
- Lepidolite 108
- Lime 73
  - production, 1894–1925 74
- Limestone 107
  - dust 88
  - production, 1894–1925 107
- Lithia 108
- Lorenz Hydraulic Mine 43
- Los Angeles County 136

- Macadam 88
- Madera County 137
- Magnesite 74
  - duty on 78
  - imports of 77
  - occurrence of 75
  - producing districts 75
  - production, 1887–1925 78
  - uses of 75
  - values of 77
- Magnesium salts 124
- Manganese 49
  - imports of, from Brazil 49
  - total production 49–50
- Map, outline of California showing oil fields 27
- Marble 79
  - production, 1887–1925 79
- Marin County 137
- Mariposa County 138
- Mariposite 88
- Mashaw & Swanson, cited 20

PAGE
Masser, H. L., cited 17
Melhase, John, cited 100
Mendocino County 138
Mercantile Trust Review, cited 45, 68
Merced County 138
Metals 34–61
Mica 108
Mineral industry, review of 11
  graph showing annual value and increase 14
  output by counties 13, 128–153
    by substances 12
  output, comparative value, 1924–1925 13
  paint 109
  production of, California, totals by years, since 1887 14
  water 110
    effect of prohibition on 110
    production, 1887–1925 111
Minerals, total production of, by years 14
  variety of, produced in California 11
Mining Bureau Act 154
Miscellaneous stone 83
  production, 1893–1925 89
Modoc County 139
Molding sand 86
Molybdenum 50
Mono County 139
Monterey County 139
Montmorillonite 100
Monumental stone 72
Morganite 101

Napa County 140
Natural gas 15, 16
  chart, production and utilization 18
    production casing-head gas 18
  gasoline from 19
  production, 1888–1925 18, 19
Nevada County 141
Nickel 51
Nitrates 124
Nitrogen, atmospheric, fixation of 124

Oil (*See* Petroleum)
  fields, chart of approximate location of 27
  lands, proved 33
  shale 113
Onyx 79
Orange County 141
Osmiridium 51
Oxychloride cement 78

Pacific Gas & Electric Co., cited 15
Palladium 51
Paving blocks 84
Peat 15
Pebbles for grinding mills 84
P. & H. gasoline steam shovel 84
Petroleum 20–33
  average price by counties, 1916–1925 22
  capitalization 30
  dividends from 31
  drilling and development 21
  features of, 1925 21
  financial tables 30–32
  map of California, approximate location of oil fields 27
  operating costs by fields 32
  outlook for 1926 21
  prices by fields 32
  production, 1875-1925 24
  production and value by counties 22
  production by fields 25, 28
  production of light and heavy gravities 25
  production statistics, 1925 22, 25, 28
  proved oil land 33
  statistics of well operations 24
  storage of 26
    and price changes 21
  yield per day of wells 24, 28, 32
Phosphates 111
Pierce gravel gold washing machine 45
Plaster and brick sand 86
Plaster mill 104
Platinum 51
  consumption of, by industries 52
  from blister copper 52
  production of, 1887–1925 53
  stocks 53
  uses, markets and consumption 52

PAGE
Plumas County 142
Porcelain 96, 115
Portland Cement Co., Imperial Co. 104
  new cement plant 68
Potash 125
  total production of 125
Pottery clays 94
Proved oil land 33
Publications of State Mining Bureau 157
Pumice 111
Pyrites 112
  total production 112

Quartz 101
  crystals 101
Quicksilver 53
  imports of 54
  production, 1850–1925 55
  production of, in United States 54
  prices 53
  uses of 54

Radioactivity of hot springs 110
Red earthenware 96
  roofing granules 88
Reed, A. H., cited 98
Rhodonite 101
Riprap 88
Riverside County 142
Roofing granules 88
  sand 86
  slate 82
  tile 96
Rubble 88
Rubies 102
Ruthenium 51
Railroad Comm., cited 17

Sacramento County 143
Salines 120–127
'Salt cake' 127
Salt 126
  production, 1887–1925 126
San Benito Asbestos Co. 91
San Benito County 143
San Bernardino County 144
San Diego County 144
San Francisco Bulletin, cited 23
San Francisco County 145
San Joaquin County 145
San Luis Obispo County 146
San Mateo County 146
Sand and gravel 85
Sandstone 80
  production, 1887–1925 80
Sanitary ware 96
Santa Barbara County 146
Santa Clara County 147
Santa Cruz County 147
  Portland Cement Co. 66
Sapphires 102
Scheelite 58
Semi-vitreous tableware 96
Serpentine 81
Sewer pipe 96
Shale oil 113
Shasta County 148
Sierra County 148
Silica 114
  total production 115
Sillimanite 115
Silver 55
  chart, prices, bar silver 56
  production by counties 56
  production, 1880–1925 57
Siskiyou County 149
Slate 81
  production, 1889-1925 83
  roofing on residence 82
Soapstone 116
  total production 117
  uses 116
Soda 127
  total production 127
Solano County 149
Sonoma County 149
Specific gravities of oil produced 25
Spelter (*See* Zinc)

PAGE

- Spessartite, 101
- Standard Oil Bulletin, cited, 26
  - Company, cited, 25
- Stanislaus County, 150
- State Mineralogist Report, cited, 17, 21, 23, 25, 26, 55
  - list of, 157–159
  - Oil and Gas Supervisor, cited, 17, 20, 21, 25, 26
- Steatite, 116
- Stocks of copper in United States, 42
  - platinum in United States, 52
- Stone, miscellaneous, 83–89
  - production by counties, 88
  - production by years, 89
- Stoneware, 96
- Strontium, 118
- Structural materials, 62–89
- Stucco dash, granules for, 86, 88
- Sulphur, 118
- Sutter County, 150

- Talc, 116
  - uses, 116
- Tehama County, 151
- Terra cotta, 96
- Tile, 96
- Tin, 57
- Topaz, 101
- Torbanite, 113
- Tourmaline, 38, 101
- Trans. Amer. Inst. Min. Eng., cited, 38
- Travertine, 79
- Trinity County, 151
- Tube mill pebbles, 84
- Tuff, used for building stone, 70, 72
- Tulare County, 151
- Tungsten, 58
  - total production, 59
- Tuolumne County, 152
- Turquoise, 102

- United States Bureau of Mines, cited, 20, 41, 44, 52, 54, 56, 74, 82, 92, 113
  - Dept. of Agriculture, cited, 110
  - Geological Survey, cited, 24, 42, 47, 55, 78, 102, 110
  - Tariff Comm., cited, 76

- Vanadium, 60
- Ventura County, 152
- Volcanic ash, 111
  - cinders, 86

- Water glass, 114
- Witherite, 94
- Wolframite, 58

- Yolo County, 153
- Yuba County, 153

- Zinc, 60
  - California Zinc Co., 61
  - chart, prices slab zinc, 60
    - trend of world production, 35
  - total production, 61

o

47818 12-26 3150

STATE OF CALIFORNIA

REPORT

OF THE

Hydraulic Mining Commission

UPON THE FEASIBILITY

OF THE

Resumption of Hydraulic Mining in California

A REPORT TO THE LEGISLATURE OF 1927

CALIFORNIA STATE PRINTING OFFICE
CHARLES A. WHITMORE, State Printer
SACRAMENTO, 1927

49846

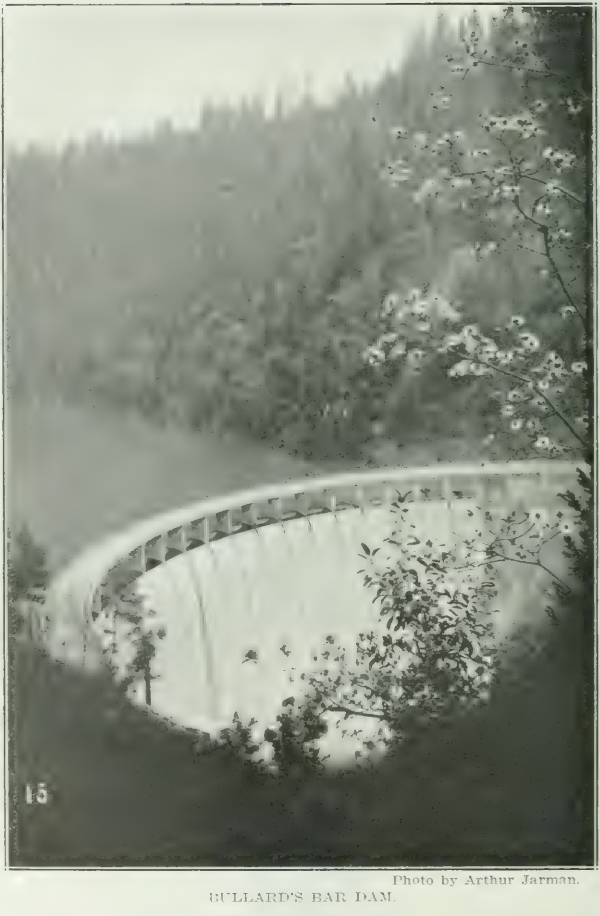


Photo by Arthur Jarman.

BULLARD'S BAR DAM.

On the North Fork of the Yuba River. Erected by Yuba River Power Company; completed January, 1924; effective height, 175 feet; length of crest, 520 feet; impounds 31,600 acre-feet of water. – 10,000 horsepower is developed here and sold to the Pacific Gas and Electric Company for distribution. Mining is allowed behind this dam upon payment of a charge per cubic yard of gravel. Photo taken April 2, 1926. Flow of water, 1700 second-feet or 68,000 miner's inches. Water perfectly clear—suspended matter is less than 1 part in 10,000,000 of water.

TABLE OF CONTENTS.

Page

Letter of Transmittal with Recommendations of the Commission 5

Letter to the Commissioners from Arthur Jarman summarizing the report 9

Acknowledgments 11

Review of the Problem 12

Recommendations 14

Discussion of these Recommendations and Costs of Dams Required 14

Payments for Impounding Debris from Mines 16

Account of Investigation of Dam Sites and Impounding Costs 19

Settlement Behind the Dams and Turbidity of the Overflow 21

Restraining of Natural Debris and Value for Flood Control 25

Power Developable 26

Relation of this Plan to the Proposed State Plan of Water Conservation 28

Growth and Decline of Hydraulic Mining 29

Benefits that were intended for the Hydraulic Mines in the California Debris Commission Act 32

Result of the Present Inquiry 32

Letter from Yuba River Power Company offering the whole of the Debris Storage in the proposed Dam at the Narrows on the Main Yuba River 35

Letter from California Debris Commission with Preliminary Estimates of Storage Capacities and Costs of Construction of Dams 36

EXAMINATION OF THE GRAVELS
- North Fork of the American River 39
- Middle Fork of the American River 51
- Bear River 57
- South and Middle Forks of the Yuba River 69

ILLUSTRATIONS.

Bullard's Bar Dam Frontispiece

Dam Site on North Fork of the American River 18

The Narrows on the Main Yuba 22

Depot Hill Mine (Joubert's) 24

Stewart Gravel Mine at Gold Run 42

Liberty Hill Mine on Bear River 60

Malakoff or Bloomfield Hydraulic Mine 77

Map showing locations of Dam Sites prepared by the California Debris Commission, and location of gravels marked by Hydraulic Mining Commission In pocket

LETTER OF TRANSMITTAL.

February 17, 1927.

To the Members of the Legislature,
State of California,
Session of 1927.

Pursuant to the provisions of Chapter 270, Statutes of 1925, calling for an investigation of the feasibility of any plan or plans whereby hylraulic mining can be resumed in California, this commission, consisting of the state mineralogist and the surveyor general, engaged Mr. Arthur Jarman, mining engineer, to undertake the field work and prepare the technical report.

Hydraulic mining is regulated and controlled by the California Debris Commission under federal statute. That commission offered their collaboration and assistance in the investigation, and have made surveys, capacity estimates and preliminary estimates of costs. Complete and cordial cooperation was maintained throughout the progress of the work; and our thanks are hereby tendered to Major C. S. Ridley, Secretary, and the other members of the California Debris Commission.

The investigation shows that hydraulic mining may be resumed, not only without fear of damage to farming and other interests, but with positive benefit to them, provided that impounding dams be constructed at strategic points, as shown on the map of the area under consideration. Preliminary estimates show that the erection of three dams and the purchase of storage in a fourth dam at a total cost of $2,405,000 would enable this industry to be resumed on the Bear, American and Yuba rivers.

Mr. Jarman reports that the available water will only suffice for one-fourth of the activity of the early '80's and that the shortage of water will mainly restrict work on gravels above the average in gold content. His forecast is an annual output of gold only one-seventh that formerly obtained from the district described. Approximately 10,000,000 cubic yards, estimated to yield $1,156,000, would be mined annually compared with 38,610,000 cubic yards in 1880, estimated to have yielded $8,000,000.

To restrain the gravel from mines in this district suitable sites for dams have been selected and surveyed and at each of these the rock conditions must be tested by drilling. Some detail surveys are also needed to supplement and check the data already obtained. This work is required on Lower Bear River site, two sites on the Middle Fork of the American River, two sites on the North Fork of the American River, and at the Narrows site on the Main Yuba. Six sites in all and possibly a seventh to enable a wise choice to be made for four dams.

This work is estimated to cost from $50,000 to $60,000 and until this preliminary engineering work has been carried out, it is not possible to decide the exact position for the construction of any dam or ascertain its cost closely enough to call for bids for its construction.

RECOMMENDATIONS.

State Legislation Required.

Assemblyman H. C. Cloudman was responsible for the bill that created this commission of investigation, and he has already introduced Assembly Bill No. 681, the object of which is to provide for the above work to be done.

Your commission recommends that the preliminary engineering to be done under this bill be done by the engineers of the California Debris Commission, as the commission must certify to the utility and practicability of the storage sites, as provided in Section 5 of the California Debris Commission Act.

The plans prepared for the construction of dams will be coordinated with those for the development and conservation of the water resources of the state, as outlined in Bulletin No. 12 of the Department of Public Works, recently issued. The dam at the Narrows will be so constructed that it may subsequently be raised to the maximum practicable height as forecast in that bulletin.

Upon receipt of favorable reports upon these dam sites and of estimates of debris that may be allowed to be mined behind dams built thereon, and upon receipt of estimates of the costs of such dams this commission recommends that the balance of the moneys remaining unexpended under the appropriation named in this bill be utilized for the purchase of lands required as dam sites and as areas to be flooded.

When estimates of the costs of dam construction on the Bear River and the North Fork and Middle Fork of the American River have been received, further legislation will be required to provide money for their construction, and vesting the debris storage in the California Debris Commission. Preliminary estimates indicate that $905,000 will suffice for these dams, including the $300,000 expenditure upon the dam sites.

When the site at the Narrows on the Main Yuba has been drilled and plans for the proposed dam confirmed as suitable by the California Debris Commission and the allowable yardage of debris calculated therefor, legislation will be needed to provide a sum of $1,500,000 to purchase the total debris storage that can be obtained there by the erection of a dam to a crest elevation of 520 feet. This is in accordance with the letter printed on p. 35 of this report. This dam will provide a large amount of storage at a low price, which will enable the large low-grade gravels of the Yuba to be worked. No other dam sites examined showed costs that would enable these gravels to be worked, as revenue from power developable was too small in each case.

The total expense anticipated is therefore $2,405,000, and should be provided one-half by the State and one-half by the Federal Government as was done for the protection work on the Yuba above Marysville quoted on p. 13 of this report.

Federal Legislation Required.

Your commission recommends Mr. Jarman's suggestions that legislation be introduced in Congress to enable the California Debris Commission to purchase debris storage in a dam in lieu of actually building a dam.

Also to amend the manner of charging a mine for restraining its debris in such a dam, or in a dam built by the Commission, by making a charge per cubic yard of debris discharged from the mine in such manner that it will be restrained in whole or in part by the dam, credit being given for boulders and material permanently stacked at the mine.

Also to provide that the charge to be made per cubic yard shall be calculated so that the capital cost of the dam shall be returned by the mining of the yardage of debris estimated by the California Debris Commission as restrainable by the dam. The total cost of the dam would be divided by the allowable yardage of debris in order to ascertain the charge to be made per cubic yard. The existing provision of a charge of 3 per centum of the gross proceeds of a mine is much too small, producing only one-third of the cost in most cases.

The sections of the Caminetti Act which provide for the protection of river channels and lands adjacent thereto should remain unaltered, and the above are the only recommendations made that affect this Act.

Benefits to Be Obtained by the Adoption of the Above Program.

1. Revival of Nevada and Placer counties, due to useful and productive work, requiring the employment of a considerable number of men in mining and other work dependent upon it.
2. Benefit to Marysville, Sacramento and San Francisco, due to orders for piping and mining machinery, materials and supplies, timber and general merchandise.
3. Development of additional water supplies for mining that will be stored in the higher regions and released as used for mining. This will assist all plans for water conservation at lower elevations, and tend to reduce salinity in the lower reaches of the Sacramento River.
4. The effects of the above will be felt as soon as the construction of dams is started. The miners will prepare for work by driving tunnels and repairing sluices and refitting their mines as soon as it is assured that debris will be stored at a reasonable price so that hydraulic work may be resumed with due protection to farm lands below.
5. Natural debris will likewise be prevented from being carried downstream and this will benefit the navigable channels by reducing the amount of dredging required. Dredging on the Sacramento River costs 6 cents per cubic yard, and the cost of restraining debris by a dam is less than one-third of this.
6. The Narrows Dam near Smartsville will render available considerable power and also water. The latter will be at an elevation of 520 feet, enabling it to be distributed over a large area of land with great benefit to the district below.

Respectfully submitted,

LLOYD L. ROOT,
State Mineralogist,
W. S. KINGSBURY,
Surveyor General,
Commissioners.

CALIFORNIA HYDRAULIC MINING COMMISSION—1925.

February 1, 1927

THE HON. W. S. KINGSBURY, Surveyor General,
LLOYD L. ROOT, State Mineralogist,
Commissioners.

GENTLEMEN: This report has been delayed owing to the time required for calculating the impounding capacities and construction costs of dams upon various dam sites considered. The figures were received from the California Debris Commission on January 26, 1927. They are estimates of impounding capacities and preliminary estimates of the costs of dam construction. They are given on pages 36 and 37.

The surveys and calculations involved much careful and detailed work and without this cooperation on the part of the California Debris Commission it would have been impossible for me to have formulated for your consideration the plan now submitted. In these surveys and estimates we are particularly indebted to Mr. R. L. Egenhoff, Engineer to the California Debris Commission, and to Mr. Harold F. Grey, in charge of the survey parties.

Because dams for the retention of hydraulic mining debris should be constructed, maintained and administered by the California Debris Commission to insure the protection of navigable channels and lands below, and because of the benefits to the state by the revival of mining and other industries involved, it is recommended that the State and Federal Government combine to provide the dams recommended.

Payments made by miners for the retention of their debris by these dams will constitute a revolving fund for the continuance of their work under the control of the California Debris Commission under the provisions of Sec. 23 of the Caminetti act of 1893. (See p. 16 of this report.)

The recommendation now made is that a sum of $300,000 be appropriated for preliminary engineering necessary to obtain precise data upon those dam sites that give promise of favorable results upon Bear River, and the North Fork and Middle Fork of the American River, and to acquire the lands affected. Detail surveys are required on these sites and drilling to ascertain rock conditions to enable final estimates of dam construction to be calculated. If this work be started in the spring of 1927 it could be completed in that year. The preliminary estimates just completed indicate that a sum of approximately $905,000 will provide dams for twenty years of hydraulic mining on these streams. The gold production from this work is estimated to exceed $8,000,000 in that time. Payments by miners for debris stored during this period will automatically provide capacity for further work.

In addition to the above it is recommended that storage be purchased in a dam to be constructed by a private corporation at the Narrows site on the Main Yuba River. The quantity offered for purchase is the total debris storage of a dam to be erected to a crest elevation of 520 feet above sea level, some water space being reserved for hydro-electric power and irrigation purposes. The calculation of debris capacity will be subject to approval by the California Debris Commission in the usual manner. Preliminary estimates show 350,000,000 cubic yards and a cost of $1,500,000. The balance of the cost will be carried by the power and irrigation features of the project. This is a much greater amount of storage than could be obtained for the same money at other sites surveyed on the Yuba. It will enable mines to work on both the South and Middle Yuba rivers. The production for 20 years is estimated at $14,000,000 from about 130,000,000 cubic yards of gravel. At the end of the 20 years there will still be space in this reservoir for another 20 years of work at the same rate.

The storage would be vested in the California Debris Commission and would be paid for by mines operating behind the dams according to the yardage of gravel washed each season, as measured at the mine, credit being given for material permanently stacked at the mine, the surveys being made by the Commission or as directed by the Commission. Power to purchase debris storage in lieu of erecting a dam would have to be added to the Caminetti Act by Congress. It is also necessary to enact a new method of charging for impounding debris according to the actual volume of gravel discharged from the mine. The act now specifies a charge of 3 per centum of the gross output of each mine. This is so small that the dams would never be paid for.

It is now suggested that the charge for each river be determined separately, the basis being the return of the capital outlay by the time the allowable debris has been worked above the dam. In this report the dams have been calculated to allow 20 years' work. In the case of the Main Yuba River at the Narrows it would take 40 years of work at the rate calculated but the development of extra water supplies and improvements in methods would speed up this work and reduce the time. 300,000,000 cubic yards at $1,500,000 would be 0.5 cent per cubic yard which is low enough to insure the working of these low grade gravels. The determination of impounding costs must await the exact estimates of construction costs which can not be made until drilling has been carried out at each dam site.

The preliminary estimates of the above plan total $2,405,000. This initial outlay will enable hydraulic mining to be revived on the Bear, American and Yuba rivers to an annual production exceeding $1,150,000, and will provide for the gravel that will be mined in the first 20 years, and for a much longer period on the Middle and South Yuba rivers. The cost of the dams and purchased storage will be returned by debris impounding fees, which, under the Caminette Act, are used for maintenance and to provide additional storage as required.

This plan is feasible and can be carried out at much below the capital cost involved in any other plan that has been suggested as a solution of the troubles of the hydraulic miner. It deals only with gravel that can be mined with the existing water supplies.

Respectfully submitted.

ARTHUR JARMAN,
Secretary and Engineer to the Hydraulic Mining Commission.

ACKNOWLEDGMENTS.

Grateful acknowledgment is made to those who assisted in the gathering of data required and in facilitating the inspection of the gravels.

To Messrs. James D. Stewart of Auburn; Chester Bowman, John Ferguson and James Nelson McCormick of Forest Hill; Lyman Gilmore of Iowa Hill; Thomas B. Brady of You Bet; W. Maguire and W. W. Waggoner of Nevada City; Theodore Larsen and D. E. Bleakley of Washington and Omega, for assistance when inspecting the gravels.

For data and reports upon various properties thanks are tendered to Messrs. Malcolm Lindsay of Denver; J. Henry Schnitzel of Lead, South Dakota; F. A. Goodale of Los Angeles; James D. Stewart of Auburn; W. Maguire and W. W. Waggoner of Nevada City.

To Mr. Ernest A. Bailey, Flood Engineer, Sacramento, for enabling me to visit the flood control works from the mouth of the Sacramento River to the Tisdale Weir, most of this in his company, with the benefit of obtaining information on the flood control problem at first hand.

To Mr. W. T. Ellis, Levee Commissioner, of Marysville, for inspecting and explaining the flood protection system around Marysville.

To Mr. Paul Bailey, State Engineer, for cordial cooperation concerning the relations of the proposed plan to that proposed for the conservation of the waters of the state.

To Mr. Edward Hyatt, Chief, and Mr. Everett W. Bryan, Assistant Chief, of the Division of Water Rights, for information on the waters appropriated from rivers.

To the California Debris Commission for the preliminary estimates of costs of dams, without which this report could not have been made, and for the preparation of the map. Also, for the cordial manner in which this work has been carried out with full cooperation to make it of greatest benefit to the hydraulic mines of the district surveyed. For planning this work and supervising it, thanks are especially due to Mr. R. L. Egenhoff, Engineer to the California Debris Commission, also to Mr. Harold F. Grey, in charge of the field parties, and to both these gentlemen for calculations of capacities and costs.

To the Hydraulic Mining Commission, the Honorable W. S. Kingsbury, Surveyor General, and Mr. Lloyd L. Root, State Mineralogist, I wish to express my appreciation of the courtesies extended to me and for freedom of action in the conduct of the investigation.

ARTHUR JARMAN.

AN INVESTIGATION OF "THE FEASIBILITY OF ANY PLAN OR PLANS WHEREBY HYDRAULIC MINING OPERATIONS CAN BE RESUMED IN THIS STATE."

REVIEW OF THE PROBLEM.

Production in the Old Days.

As nearly as can be ascertained, in the palmy days of hydraulic mining the annual production reached $15,000,000 and averaged $10,000,000 for about thirty years immediately prior to 1884, when injunctions were issued to prevent the discharge of debris into the rivers.

Present Production.

By 1908, the total production for drift, hydraulic and other gravel mining had fallen below $1,000,000 due to the stoppage of hydraulic mining and the partial exhaustion of the richer drift mines.

In 1924, hydraulic mines, for the whole state, produced only $60,195* and in 1925 produced $175,345.

For the six years 1920 to 1925 hydraulic work averaged $122,114 per annum, and of this amount less than $60,000 was produced by counties that drain into the Great Valley of California. More than half of it was from counties that are not subject to restrictions because their rivers discharge into the ocean without navigable channels.

The drop from $10,000,000 to $122,114 per annum shows that hydraulicking has almost ceased and unless substantial assistance be given at an early date this industry will die as the remaining water resources will gradually be taken for other purposes.

Possibility of Reviving Hydraulic Mining.

A general revival is impossible because of the altered conditions of the times and because much of the water supplies that formerly belonged to hydraulic undertakings have been acquired by power and irrigation interests. Making allowance for these factors, there still remain some of the largest auriferous gravel deposits known to the mining world, and **the only process by which they can be worked at a profit is hydraulic mining.** A portion of the former water supplies is still available and would enable an industry to be built up with an annual production estimated at $1,156,950, so that in the next 20 years gold would be produced to a total value of over $23,000,000, but to accomplish this **the debris must be impounded at a low cost, otherwise more than one-half of the gravel would be unprofitable to work,** being of low grade. The provision of a substantial concrete dam on each of the main streams affords the only hope of securing impounding capacity at low cost, each dam serving several mines.

---

*See the returns given in Mineral Resources of the United States, 1924, Part I, by Jas. M. Hill, p. 212.

To accomplish this it will be necessary to activate the Caminetti Act in its entirety.

This act was passed by Congress in 1893, its proper title being "An act to create the California Debris Commission and regulate hydraulic mining in the State of California," approved March 1, 1893.

The condemnatory sections were utilized on the passage of the act. These provide more severe penalties than the state laws.

The permissive sections were also put into action. These allow the miner to build a dam and on its approval by the commission he may mine up to the limit of the capacity of the dam. Miners or others may combine to erect a dam to serve more than one mine. This provision has also been used and is in action.

The protective section, or the protective provision of section 25 provides that the commission shall build dams to prevent mining debris from injuring the navigable rivers. This provision was utilized between 1900 and 1910 by the erection of barriers on the Yuba and a "cut" and dam at Daguerre Point about nine miles above Marysville. This was done to protect the channels at Marysville and the adjacent farm lands, a matter of urgency because of the large quantity of debris in the channel. This work cost $661,824.14; one-half was paid by the state and one-half by the federal government.*

Up to July 1st, 1923, the federal government has expended	$398,268.67
The State has expended	398,656.39
A total of	$796,925.06**

The vitalizing sections, however, have lain dormant and unused. These provide that dams shall be built by the commission "**when appropriations are made therefor by law**" and that for the retention of debris by such dams the miner "**shall pay a tax of 3 per centum of the gross proceeds" of his mine so worked.**

Nothing has been done under these sections to provide dams for the resumption of hydraulic mining, nevertheless they point out the way to revive hydraulic mining, by enabling the mines of each district to work behind a common dam. The creation of the California Debris Commission, charged with the specific duties of examining dam sites and erecting dams when moneys are provided for them, simplifies the problem.

The recommendations that are made result from studies of dam sites and of gravels that would be benefited by dams in these positions. An account of this investigation follows the recommendations, and a short history is given of the growth and decline of hydraulic mining, followed by details of the principal gravels that are workable on each river under the plan now proposed.

The California Debris Commission's report upon dam sites, with their impounding capacities and preliminary estimates of costs is printed verbatim. The map that accompanies this report was prepared by them and on it are shown the chief gravels that are workable.

---

* See 1910 Report of Chief of Engineers, U. S. Army, pp. 1010-1011.

**See letter from the Reclamation Board of California to the Hon. C. F. Curry, Feb. 1924, p. 54.

RECOMMENDATIONS.

1. As a result of surveys and calculations, five dam sites were found to be unsuitable because of high cost per cubic yard of impounding capacity. Six showed promise of reasonable cost per cubic yard of gravel and it is recommended that detailed surveys be made of these and that drilling be done to ascertain rock conditions. If a start be made in the spring it would enable this work to be completed by the end of the year so that costs may be calculated and plans and specifications drawn up. This preliminary engineering is essential before reliable estimates for dam construction can be made. Under the most favorable circumstances and if funds were already available, no construction work would be possible before 1928.

2. The site at the Narrows on the Main Yuba requires drilling only to ascertain closely the cost of construction, but a low cost per cubic yard is assured from preliminary estimates. In this case revenue from power production and the sale of water for irrigation enables low cost to be obtained.

3. It is recommended that a sum of $300,000 be provided for preliminary engineering and for the purchase of dam sites finally recommended.*

4. From $50,000 to $60,000 is estimated as sufficient for preliminary engineering on the seven sites to be examined and the balance of the $300,000 should cover the purchase of sites and lands when the most suitable sites have been determined. The engineering work now recommended will be a continuation of that done by the commission in 1926-1927.** The money required should be made available to supplement the annual congressional appropriation of $15,000 which covers the ordinary work of the commission and does not go far when special work of this kind is undertaken.

Discussion of These Recommendations.

When final estimates have been made, appropriations will be required to enable dams to be built and debris impounding capacity to be purchased by the California Debris Commission according to Table I which shows the output estimated for twenty years of work under this plan and the cost of debris storage according to the preliminary estimates, the total being $2,405,000 for the five rivers.

---

*Provided for by Assembly Bill No. 681, introduced into the State Assembly by Harold C. Cloudman, member for the 40th district, proposing to appropriate $300,000 for these purposes.

**The California Debris Commission is charged with the duty of examining dam sites under the Caminetti Act which says: "That it shall further examine, survey, and determine the utility and practicability, for the purposes hereinafter indicated, of storage sites. * * *"

TABLE I.

Estimate of Dams Required for Twenty Years' Work.

River	Amount of gravel estimated to be washed in 20 years (cubic yards)	Debris capacity of dam (cubic yards)	Preliminary estimates of total cost of dam	First cost in cents per cubic yard of gravel	Name of dam site	Particulars of dam
North American	23,000,000	21,000,000	$470,000	[1]$2 24	Owl Creek	Dam crest 137 feet above low water.
Middle American	13,280,000	22,000,000	125,000	[1]0 94	Mammoth Bar	Dam crest 45 feet above low water.
Bear	26,510,000	21,000,000	310,000	1 47	Lower Bear River	Dam crest 143 feet above low water.
South Yuba	85,392,000	preliminary	estimate			This dam site is below the junction of the Middle and South Yuba and will serve both streams. Dam to be built to 220 feet above low water.
Middle Yuba	52,000,000	[2]350,000,000	[3]1,500,000	under 0 50	Narrows	
Totals	200,182,000	400,000,000+	$2,405,000			

[1] Another site is to be examined that should give lower cost.
[2] This figure not yet checked by the Debris Commission.
[3] For purchase of total debris storage capacity allowable.

The building of dams by the California Debris Commission is provided for by the act of 1893 which created the commission, but the alternative of purchasing debris impounding capacity in a dam built or proposed to be built in accordance with the commission's requirements has not been included, and an amendment would be needed to enable debris impounding capacity to be purchased by the commission. Table II shows that the charge of 3 per centum of the gross output of a mine for impounding its debris would not repay the first cost of the proposed dams. To accomplish this the method of charging should be changed by an amendment providing for a charge per cubic yard of gravel washed, credit being given for material stacked and retained at the mine.*

Table II also shows the charges per cubic yard required to return the capital cost by the time that the debris capacity of the dam has been mined.

---

*This is discussed further on page 17.

TABLE II.

Costs of Dams Compared with Debris Payments Calculated at Three Per Cent of the Probable Gross Yield and Compared with Debris Payments at Rates per Cubic Yard That Will Return the Costs
Results for Twenty Years' Work.

River	Cubic yards debris	Dam payments at proposed rate per cubic yard	Suggested rate in cents per cubic yard	Dam payments at three per cent of yield	Cost of dams	Gold production expected
North American	23,000,000	$515,000	*$2 24	$79,200	$470,000	$2,640,000
Middle American	13,280,000	125,000	0 94	40,416	125,000	1,347,200
Bear	*(21,000,000) 26,510,000 expected	310,000	1 47	125,010	310,000	4,167,000
South Yuba	85,392,000	[2]686,960	0 50	449,544	3,090,000	9,784,800
					745,000	....
Middle Yuba	52,000,000				1,150,000	5,200,000
Main Yuba[1]	....	....	....	....	1,500,000	....
Totals	200,182,000	$1,636,960	....	$694,170	$2,405,000	$23,139,000

*An additional site to be examined in each case with the object of obtaining lower cost on the North Fork of the American River, and a larger capacity on Bear River.

[1] Same figures as for Middle and South Yubas with some gravel below Freemans not estimated.

The three dams originally considered on the South and Middle Yubas would have cost a total of $4,895,000 which is too high for work to be possible behind them on low grade gravels. Substitute for these three the purchase of storage on the Main Yuba at the Narrows for $1,500,000.

[2] Payments for the first twenty years only.

Payments for Impounding Debris From Mines.

A charge per cubic yard of debris discharged into the stream or channel is recommended. The act of 1893 stipulates 3 per centum of the gross production as payment for impounding debris. Unless the gravels are richer than 15 cents per cubic yard, the payments will only produce one-half cent per cubic yard. It has already been shown that the cost of providing impounding capacity is higher than this, leaving out of account the loss of interest on capital expended. Revenue derivable from water used for irrigation or for power production is discussed on p. 26, and is small for the dams considered because the effective height is small.

The dams proposed must develop storage capacity at low cost, otherwise the plan will not restore hydraulic mining because mining must pay the cost of storing the debris. Any plan which does not provide that mining shall pay for the actual storing of the debris is economically unsound. In the Caminetti Act, section 23 provides that "All sums of money paid into the treasury under this section shall be * * * expended by the said commission * * * in the construction and maintenance of such restraining works and settling reservoirs as may be proper and necessary."

In this manner payments for the storage or restraining of debris are utilized to provide new storage capacity as well as to maintain old dams, and if these payments equal the capital cost we shall have a revolving fund that will continue to provide the industry with settling reservoirs. But if the payments be insufficient to return the cost of providing dams, then the fund will diminish until extinguished.

The method of charging for this service is immaterial to the argument, but any amendment would require action by congress.

The first calculations made for this report were based upon 20 years of work under the 3 per centum payments, and an inspection of

Table II shows that 3 per centum would be inadequate and the revolving fund would quickly disappear. If all gravels were charged the same rate per cubic yard the payments would be sufficient on some rivers and insufficient on others. It appears most logical to determine the charge at each dam irrespective of the charge made at any other dam because conditions differ on the various rivers.

Provision should be made for the receipt of revenue derivable from the sale of water for power production or for irrigation, and this should be credited to the state.

It is impossible to estimate exactly the yield from the gravels, therefore it is futile to calculate greater revenue derivable from a greater percentage charge. A charge per cubic yard of debris discharged into the stream or channel is rational, and it is suggested that this charge be based upon the return of the cost of the dam by mining the quantity of debris allowed to be mined behind it.

Where there is a large percentage of heavy boulders there is no sense in encouraging the discharge of such material into the water courses. In many cases it would be cheaper to stack this on the bedrock of the mine, using an electric derrick. When this is done, the survey should make an allowance for the quantity so retained on the bedrock of the mine. Such heavy material would never reach the dam but might reach the main water courses; stacking it at the mine should be encouraged and not penalized. If charged for as though retained by the dam the effect is to raise to a high figure the charge per cubic yard mined. This is not equitable, and may prevent the earning of a profit.

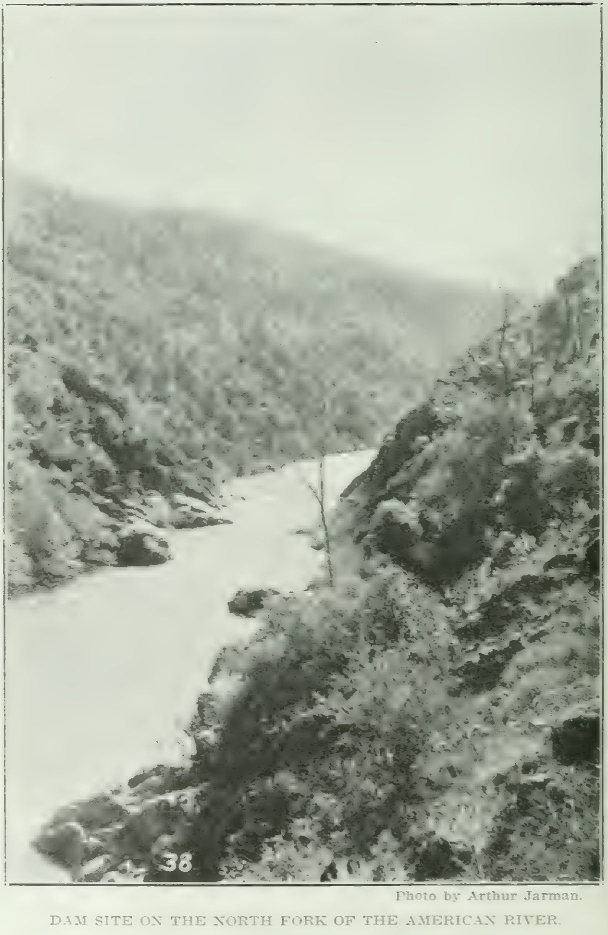


Photo by Arthur Jarman.

DAM SITE ON THE NORTH FORK OF THE AMERICAN RIVER.

View looking downstream from the north bank.

ACCOUNT OF THE INVESTIGATION OF DAM SITES AND IMPOUNDING COSTS.

It was anticipated that large dams at the sites first chosen would provide impounding capacity at low cost and enable mining to be developed on a scale that would be profitable. While surveys and calculations were in progress, further inspections of the gravels were made, to ascertain the gravel that would be worked and gold produced annually by mining behind these dams if impounding costs were favorable. In most cases a period of twenty years or more would be required to mine the gravel available with the existing water supplies and therefore costs were calulated for dams to provide capacity for twenty years work.

Choice of Dams.

Section 25 of the California Debris Commission Act directs that the recommendations already made concerning dam sites shall be the basis for future work. Existing surveys were extended where necessary to gain additional impounding capacity. New surveys were also made.

Mr. A. L. Wisker, secretary-manager of the Nevada Irrigation District, supplied some engineering data on the Parker dam site on Bear River, and Mr. H. A. Kluegel, consulting engineer of San Francisco, cooperated by exchanging information on dam sites on the North and Middle forks of the American River. The capacities and preliminary estimates of cost given in this report are calculated by the Debris Commission engineer and in due course will be reported to Congress.

North Fork of the American River.

Three sites were considered. That at Owl Creek was favored because it will catch debris from Iowa Hill and from the north side of Forest Hill. That at Rice's Bridge on the road from Colfax to Iowa Hill was surveyed. This is a good dam site but would not catch Iowa Hill or Forest Hill material. Seven miles below Owl Creek is the North Fork site above the junction of the Middle Fork. This gives promise of lower costs than the other two sites. Each should be examined in detail. Preliminary estimates show costs of 2 cents or less per cubic yard of debris capacity. Calculations of impounding capacities were made as follows:

North Fork site—from private surveys.

Owl Creek site—from Debris Commission survey.

Rice's Bridge site—from surveys by the United States Geological Survey in cooperation with the State Water Commission, 1912.

Preliminary estimates of costs of dam construction were made as follows: North Fork site and Owl Creek site from private surveys, and Rice's Bridge site from the Debris Commission survey.

Middle Fork of the American River.

Calculations were made for a dam at Mammoth Bar or American Falls, utilizing for this purpose a survey made by the United States Geological Survey in cooperation with the State Water Commission, 1912, and a sketch map of the dam site made in 1890. A detail survey will be required. There is another site that offers cheap storage on this river which should be examined in detail.

Bear River.

Three sites had already been surveyed, Van Giesens, Parkers, and Lower Bear River, the figures favoring a dam at the Lower Bear River site. This will catch debris from Bear River, Steep Hollow and the Greenhorn. The canyon at this point is favorable for concrete dam construction, the preliminary estimates indicating a cost under 1.5 cents per cubic yard of debris capacity. The water level would be raised above that of the Pacific Gas and Electric Company's Bear River diversion dam and canal, thus giving settled water at the intake. When this dam is filled, it could be raised or further storage obtained in a dam lower down the river at the Parker site. Rock conditions at the Parker site were reported as not so favorable for a concrete dam as at the Lower Bear River site. Parker site has been purchased by the Nevada Irrigation District and preliminary estimates indicate that debris storage there would cost from 2 to 2½ cents per cubic yard, measured at the mine.*

South Yuba River.

Two sites were surveyed, both having excellent rock bottom and sides. Operations on this stream will be larger than on any other, therefore, it was originally intended that one dam be constructed at Norton's Canon and a second one twelve miles lower down at Jones Bar. This was proposed because of the large amount of gravel that it is expected will be worked. Unfortunately the preliminary estimates for both these dams gave high costs per cubic yard of impounding capacity from 2.8 to 3.8 cents, which is much too high for gravel estimated to yield 10 cents which is the value of the Bloomfield gravel.

Middle Yuba River.

Two sites were surveyed, Freeman's and Emory's Flat. Preliminary estimates for cost of storage at Freeman's were 1.9 cents. Near Emory's Flat there is a rocky canyon but the rock is strongly jointed and might give trouble in obtaining a water-tight foundation. The impounding cost there was much higher than at Freeman's.

The principal object of a dam on the Middle Yuba is to enable the low grade gravels at North Columbia and Badger Hill to be worked. These are of great size and are estimated to yield 10 cents, and an impounding charge of 2 cents would prevent them from being mined at a profit.

Dam on the Main Yuba at the Narrows Site.

Both the Middle and South Yuba rivers would be served by a dam at the Narrows, also some gravel on the Main Yuba below the dam sites mentioned above, but a very large capacity would be needed to justify mining above this on a large scale because there is no site below the Narrows at which further impounding could be done.

---

*Telephone communication from Mr. A. L. Wisker, Jan. 25, 1927.

Fortunately a very large capacity is obtainable there. In addition there is great advantage because of the large flow of water, the flow of the Middle and South Yubas being increased by that of the North Yuba and the combined flow of the three will enable about 17,000 horsepower to be developed. Water may also be distributed to a large area of agricultural land from this point of vantage. Therefore, the purchase of debris capacity in a dam at the Narrows is the rational solution of the debris question for the South and Middle Yubas, for, by combining the three purposes of this dam it is possible to secure debris storage cheap enough to work low grade gravels. The proposal is embodied in the letter printed on page 35.

Space Left at End of 20 Years.

It will be noticed that the capacities of the dams recommended approximately equal the amount of debris expected to be produced in 20 years, except in the Narrows dam which would provide capacity for over 40 years at the estimated rate of work. In each case the debris impounding capacity is calculated with an allowance for debris lying in the canyon behind the lake of quiet water and rising at the rate of 15 feet to the mile. If the debris is retained in canyons at a different slope from this, the allowance may be changed, but in the meantime it is all that the engineers of the Debris Commission feel justified in making. When a fan-shaped deposit of debris forms at the head of a lake, the water coming down the slope will spread out over the surface and thereby lose much of its power of transporting debris. This will give a greater slope. A greater slope would very considerably augment the debris restraining capacity of each dam and lower the cost of impounding so that at the end of 20 years there may still be capacity for more debris and the water would be properly cleared before it overflows. This has been duly considered when adopting the allowance of a slope of 15 feet to the mile.

The yardage of debris that can be impounded by a dam would be the water impounding capacity plus the cubical contents of a prism bounded on the bottom by the plane of the water surface and on top by that of a surface graded back from the dam crest at a slope of 15 feet to the mile. The sides of the prism would be the sides of the canon, and the contours of these were surveyed to enable calculations of this sort to be made.

SETTLEMENT BEHIND THE DAMS AND TURBIDITY OF THE OVERFLOW.

The settlement behind the dam and consequent relative clearness of overflow is a matter of strong interest because of the benefit to the river channels below, particularly the navigable channels. The flood flow in each stream was calculated by taking the highest flow recorded in Bulletin No. 5.*

Table III. shows that when the river reaches the headwaters of the lakes behind the dams, the velocity of flow will be reduced to such a low point that the load of debris will be dropped in the still water.

---

*Flow in California Streams, being Appendix A to Report to the Legislature of 1923 on the Water Resources of California (see Table 175).

Photo by Arthur Jarman.

THE "NARROWS" ON THE MAIN YUBA.

View looking upstream from the site of the proposed dam to be erected by the Yuba River Power Company. This will afford storage for 40 years of hydraulic mining on the South and Middle Forks and Main Yuba River. Approximately 17,000 horsepower can be developed here by a dam of the height proposed, 220 feet. This will impound 72,000 acre-feet of water.

Even the "slickens" will settle because the velocities in the worst floods will only be from one-fifth to one-half foot per second.

The flow for the particular river branch was found by distributing the entire flood flow between the branches in proportion to the drainage area served by each.

At the position of maximum cross-sectional area of the lake impounded by the dam we shall have minimum velocity of current and therefore the best settlement.

Considering the flood flow passing this cross-section we obtain the velocity. It may be objected that the current does not distribute itself evenly and that there is greater velocity at the center of the channel than at the sides and bottom. The reply to this contention is that this flood flow velocity was applied to and used for times of average flow so that we have a large factor of safety. The velocities for minimum flow are not given. They would be very much lower.

At times of minimum flow the water normally in the river will be supplemented by that released from storage for use in the mines. It is at these times of small flow that turbidity will be at a maximum and not at flood time, the reason being that the proportion of debris to water will be at its highest. On some rivers there is only a small amount of unappropriated water left in the stream during the summer, and in all cases there are several summer months when "piping" stops for lack of water. During these months the miners occupy themselves with the deepening of rock-cuts, extensions of tunnels, and driving drifts and cross-cuts for the placing of powder blasts to bring down the cemented gravel.

TABLE III.

Velocities of Water in Dams at Crest of Maximum Flood.

Dam	River	Flow in second-feet	Height of dam (feet)	Cross-sectional area in square feet	Velocity at crest of worst flood
Nortons	South Yuba	32,500	270	74,500	.38 feet per sec.
Jones Bar	South Yuba	32.500	220	61,300	.53
Freemans	Middle Yuba	20,000	225	170,000	.105
			125	57,200	.35
Owl Creek	North American	34,200	190	118,150	.29
Narrows	Main Yuba	111,000	220	600,000	.19
	Ordinary flood on Main Yuba	50,000	220	600,000	.09

The Narrows Dam on the Main Yuba will restrain debris from large scale operations at Columbia Hill, Bloomfield and Omega, and it is important to notice that the velocity at times of worst flood recorded would be reduced to .19 foot per second at the widest portion of the lake. Ordinary floods for 29 years out of 30 do not exceed 50,000 second-feet flow and on these occasions the velocity would be reduced to .09 foot per second. Therefore settlement will be efficient even with operations proceeding on a large scale.

The Sacramento River at Sacramento at all times has a velocity 5 to 10 times greater than would be found in any of these dams and the turbidity found there results from that velocity.

Having calculated the flow in the dam lakes it is evident that any particles that remain in suspension would be so minute as to be microscopic and the water passing over the crest of the dam would be clear or at the worst only faintly cloudy. This clear water would benefit the navigable river channels by scouring them.

Fine sand that passes a 200 mesh sieve (having 40.000 apertures per square inch) settles readily at the low velocities given in this table. Any matter that remained in suspension would be fine colloidal material or clay that was worked with the gravel. This might discolor the water slightly but the sand and gravel that rolls down the rivers during winter rains would be permanently retained by the dams, thus benefiting the river channels below.

Prominence should be given to the fact that all surface soil and clay has been removed by former operations at Gold Run and Dutch Flat, also from much of the ground at You Bet and Little York, and for almost the whole of the enormous area available at Columbia Hill (or North Columbia). This very materially reduces the problem of settlement of mud from the water after use. After injunctions were obtained and mines were obliged to impound the debris caused by hydraulicking, further trouble was caused by the extreme turbidity of water and the **large amounts of actual debris in water that flowed from dams**; this eventually resulted in the tight shutdown of hydraulic mines. The miners were to blame in allowing debris to flow past the dams and **deliberately causing it so to do**. This is now a matter of history, but it explains the strong feelings of the farmers

Photo by Ernest A. Bailey,
Flood Engineer, Sacramento.

DEPOT HILL MINE (Joubert's).

[illegible] North Fork [illegible] Yuba River [illegible] Bullards Bar Dam [illegible] and accounts for their employing agents or "spies" to report such matters.

Since 1897 the Debris Commission has generally required dams to be of masonry or concrete construction in flowing streams to obviate failure and to prevent tampering with the structure. The success of such structures for the settlement of fine materials is seen at Bullards Bar on the North Yuba River. In April, 1926, when I visited this dam there had been good rains and a depth of nine-tenths of a foot of water was overflowing the crest from end to end (see Frontispiece), the total flow through the lake being 1700 second-feet, yet the water was so clear that not the slightest cloudliness could be detected by eye, i.e., the suspended matter was below one part in 10,000,000. Clays from natural denudation and from small hydraulic operations had settled completely.

THE RESTRAINING OF NATURAL DEBRIS AND VALUE FOR FLOOD CONTROL.

Mr. Ernest A. Bailey, engineer for Flood Control, Sacramento, has taken great interest in the relations of this hydraulic work to that of flood control in the Sacramento Valley, and I have had the pleasure of visiting most of the flood control works in his company. These flood control works represent a considerable capital expenditure and it is well to emphasize the fact that the clear water from the proposed dams will increase the scour of the river channels and in this way assist in reducing the flood menace in the Sacramento Valley.

Rivers flowing through mountain districts have steep gradients and therefore a high carrying power. They have beautifully clear water in the summer months of small flow because the winter freshets have carried away all the light material that causes turbidity. In winter they have heavy loads of sand and gravel and are turbid with clay and soil washed from the hillsides. This material is carried down to the quiet stretches of river where most of it is deposited and is later removed by dredging. The finest particles remain in suspension and pass down to the harbor.

Very little data is available on the subject of turbidity of the rivers mentioned in this report. A few samples were taken from the surface of these streams and they showed considerable sand during winter months. Gravel also rolls down the bed of the stream but this can not very well be measured. It is known to move downstream during winter floods because pools become cleared from gravel that is dumped into them. Debris dams will prevent this natural debris from travelling downstream and will thereby benefit the channels below. The clear water that overflows the dams will assist by scouring the channels of the rivers below, and in this way materially assist in reducing the danger from floods. The dams proposed are not large enough to be used for flood control, but the combined effect of storage of water for use above the mines and restorage below them in the debris dams will operate in the direction of reducing the peaks of floods.

Sediment in Some Samples from Rivers Dealt With in This Report.

River	Locality	Date	Sediment in parts per 1,000,000 by weight	State of the river
South Yuba	Edward's Bridge	Apr. 9, 1926	103	Fine weather and good flow of clear water
South Yuba	Washington	Jan. 2, 1927	1,560	Raising river, freshet, water very turbid.
Wolf Creek	Above Junction	Apr. 8, 1926	238	Creek in flood—raining.
Bear River	Gautier Bridge	Apr. 8, 1926	1,080	Big Flood—raining.
Willow Creek	Garden Valley	July 2, 1926	510	
Pine Grove	Jacksons	Mar. 10, 1926	90	
Sacramento	S. P. Bridge	Apr. 10, 1926	32	High water, flood subsiding on American River, but at its highest on the Feather.
Sacramento	S. P. Bridge	Dec. 10, 1926	96	High water, a few days after the levees were in danger at Colusa.
North Yuba	Bullards Bar Dam	Apr. 2, 1926	less than .1	Perfectly clear; not even a faint cloudiness: 1700 second-feet or 68,000 miner's inches overflowing the crest of the dam.

THE POWER DEVELOPABLE.

Calculations were made based on the figures for drainage area and seasonal run-off and distribution of run-off as given in Bulletin No. 5, "Flow in California Streams," by Paul Bailey. The results are only approximate because water is drawn off by various ditches and some of it is not returned to the stream. Daily gaugings would be needed for a long period to determine the water power available at each dam site. Nevertheless the figures obtained indicate what may be done in this way.

Provision should be made at each dam for the utilization of water power and to enable stored water to be drawn off to assist in irrigation in times of low water.

Use of Stored Water.

In dry months when the hydraulic mines have stopped piping, the water behind each dam would be valuable to farmers in country below. At these times the water may be released without affecting the work of the mines and any revenue derived therefrom would accrue to the state.

North Fork of the American River.

For four months the flow is below 3.6 per centum of the total and for three months it is less than 1 per centum. Assuming 150 feet of fall at the proposed dam, the average year will give 600 horsepower for twelve months without drawing on storage and 1200 horsepower for nine months. In the driest year recorded it would give 1200 horsepower for eight months using a dam of the size contemplated.

Middle Fork of the American River.

This dam would only give a fall of 45 feet and the fall would give 360 horsepower for the whole of the average year and 1000 horsepower for nine months. In the driest year recorded it would give 650 horsepower for more than eight months.

Lower Bear River Dam Site.

A dam with a crest 143 feet above low water would benefit the Pacific Gas and Electric Company's Bear River Canal leading to the

Halsey Power House by submerging a portion of it and supplying water free from sediment, at the same time allowing water to be drawn from storage in dry months. It would not have value as a power producer, because almost all the water is used already for this purpose being drawn off by the above mentioned canal.

Conclusion.

The value of the power developable at these dams is small because the dams are small and do not give enough fall, nor do they give enough water storage for running in dry months. It is probable that larger dams on the North Fork and Middle Fork of the American River would develop power that would pay and if so, the lower portion of the dam would serve to impound debris without detriment to the power feature of the plan. This would give opportunity for cheaper storage. Private investigations of the possibilities of power development have not proceeded far enough to enable negotiations for debris storage to be considered. Hydraulic mining and the development of power are not antagonistic. One is supplemental and helpful to the other and the development of a water storage system to give considerable pressure head for "piping" naturally leads to this system being used for hydroelectric purposes when mining ceases. The stoppage of hydraulic mining led to the transfer of many of the water systems to power companies.*

If hydraulic mines are revived by the provision of storage dams they will renovate and enlarge their water systems which at the close of all mining will naturally become useful for hydroelectric power production and irrigation. In the latter cases the charges for service are subject to strict regulation by the State Railroad Commission as such concerns are regarded as public servants. Hence, after mining ceases, the farming and general community will continue to benefit from the additional water supplies developed by mining.

As work progresses on the large gravel deposits at Gold Run and at Columbia Hill, it will be possible in each case to leave a hydraulic pit in such a position that it will have great value for water storage and power development. As the gravel approaches exhaustion and

---

*The power business in California had its beginning in the mining business. Miners pioneered the path of the hydroelectric engineers of today. Their methods of construction, the manner in which they moved heavy machinery and material into rocky, remote regions, their designs for flumes, dams, and ditches, their tangential water wheel, all left a lesson to be learned, and as the hydroelectric engineers of the new day read the record in the rocks the achievements of the sturdy men of the mountains took hold of them and inspired the vision that brought about the wonderful developments of the power industry that have made California the envy of the world. None know the story better than the P. G. & E. This company supplied more power to gold mines than all other companies in the State combined. Never an engineer goes over its system but he realizes its debt to the old miners. Ten of the company's twenty-eight water power plants were originally initiated to provide energy for mining operations. Nine of its plants were installed on canals dug to supply water for mines. Out of that same hunt for gold came ten of the company's reservoirs. Blindly, perhaps, but like a Titan, the old-time miner builded for the future. Tonight his reservoirs, feeding power plants on some Sierra slope, will light homes hundreds of miles away. Some of his canals, blasted out of the rocks in the old pack-train days of the '50's, still wind their rugged way through twenty miles and more of mountain in the great wheels that in a twinkling create the spark that spins a thousand factory wheels and makes goods, and work for multitudes, and cargoes for ships, and payrolls, and prosperity. It is a stirring tale, a tale too long to be told in a breath. It is a book, a book not yet written and too vast a work for the modest chronicler. The miner made California, and it is still his state, for the age of electricity has but sealed his title.—*California's Debt to the Miner, P. G. & E. Progress, Vol. I, No. 8, p. 2, July, 1924.*

the water power value increases, the latter may become a better source of revenue than mining for gold. On the other hand the lack of new discoveries of large gold fields and the increasing use and actual destructive consumption of gold in the arts makes this unlikely for many years. It is more probable that the purchasing power of gold will increase owing to its scarcity than decrease owing to the utilization of paper instead of coins. The use of paper for currency has probably reached its maximum.

RELATION OF THIS PLAN TO THE PROPOSED STATE PLAN OF WATER CONSERVATION.

State Engineer Paul Bailey called attention to the comprehensive scheme that his department is evolving to conserve and utilize to the best advantage the waters of the state. Several bulletins* of valuable information have already been published in connection with that inquiry.

If the water conservation plan is adopted by the state, enormous reservoirs would be constructed which would be able to accommodate the expected volume of hydraulic mining debris without its occupying more than 5 to 10 per centum of the water capacity of the reservoirs that are proposed. Two of these dam sites are marked on the map, viz. those at Folsom and at the Narrows.

It is to be hoped that this comprehensive plan for conserving the waters of the state will be adopted, or some modification of it, but the expenditure is large, and it may have to wait a time of education and campaigning before such expenditure will be sanctioned. In the meantime hydraulic debris dams can be built for a relatively small sum of money. These dams would supplement those proposed for water conservation and would in no way conflict with them.

---

*Bulletins Nos. 5, 6, 7, 8, 9 and 12.

GROWTH AND DECLINE OF HYDRAULIC MINING.

Hydraulic mining as defined by the state and federal acts "is mining by the means of the application of water, under pressure, through a nozzle, against a natural bank, thus eroding the bank." The mixture of gravel, sand, loam and water runs along rockcuts and sluices that eventually discharge on lower ground leading to streams that carry the material away. The sluices contain riffles to retain the gold that settles in them. Quicksilver is generally placed in the riffles to assist in catching the finer particles of gold.

This method of mining was invented in California in 1853. The first rigs conducted water from the ditch to the face of the gravel bank by wooden boxing and canvas hose. These were soon replaced by iron pipes which withstood considerable pressure, and after this improvement the gold obtained grew by leaps and bounds until the state became world famous for this class of mining. The scale of work reached enormous dimensions, the gravel washed by this process in 1880 being estimated as 46,025,391 cubic yards, which is equivalent to a piece of ground one mile long, one mile wide and 15 yards deep. All this was washed into the rivers in twelve months. No wonder the hydraulic miner soon had trouble on his hands. Such an enormous scale of hydraulicking has never been approached in any other country.*

Mr. Waldemar Lindgren, in his classical memoir on the Gravels of California[1] reviewed the estimate made by Gilbert[2] and by the State Engineer and by engineers of the Debris Commission, and he concluded (p. 21) that the nearest approach to a measure of the gravels that had been washed into tributaries of the Sacramento River alone was 1,295,000,000 cubic yards. Most of this was washed prior to injunctions such as the famous decision by Judge Sawyer in 1884. The rate of work quoted for the year 1880 was estimated in a report presented to Congress in 1882, by Lieut. Col. G. H. Mendell.[3]

The water used in the Sacramento Basin was obtained from the returns of the county assessors, and this information was supplemented by further information from the State Engineer's Department. Knowing the water used and having some estimates of the amount of work that could be done by a "miner's inch" of water as determined by surveys and measurements, it was calculated that the total yardage moved in the Sacramento Basin in 1880 was 38,610,926 cubic yards. Similar information concerning rivers south of the American gave a total of 7,414,465 cubic yards, so that the total for the northern half of the Grand Valley was 46,025,391 cubic yards.

---

* For a more detailed history of this trouble and its consequences, see pages 146 to 152 of a report entitled SACRAMENTO FLOOD CONTROL PROJECT, revised plans submitted to the Reclamation Board by W. F. McClure, State Engineer, February 10, 1925, (issued 1927).

[1] The Tertiary Gravels of the Sierra Nevada of California, by Waldemar Lindgren, being professional paper No. 73 of the United States Geological Survey.

[2] Hydraulic Mining Debris in the Sierra Nevadas, by Grove Karl Gilbert, being professional paper No. 105 of the United States Geological Survey.

[3] Mining Debris in California Rivers, Ex. Doc. No. 98, 47th Congress, 1st session.

This is shown in the following table which is compiled from tables given in Lieut. Col. Mendell's report (pp. 15 and 16):

River	Water used, miner-inch-days	Duty, cubic yards per M.I.D.	Gravel moved cubic yards
Table Mountain or Dry Creek	833,250	3½	2,916,375
Butte Creek	24,000	3	84,000
Feather River	1,259,363	3½	4,407,770
Yuba River	5,458,171	3½	19,103,598
Bear River	1,117,082	3	3,351,246
Dry Creek No. 2	44,229	3	132,687
American River	1,914,500	4½	8,615,250
Totals	10,650,595		38,610,926
Rivers south of the American	3,384,370		7,414,465
Grand totals	14,034,965		46,025,391

The deposits on the Feather River are dispersed over a large area, but those on the Yuba, Bear and American rivers are closer together, making a district that was one of considerable activity. All the material in the upper part of the table was eventually discharged into the Sacramento River and its tributaries above the capital city.

The immense scale of these operations caused serious silting of the river channels and partial blockage of streams tributary to them, so that in flood times much damage was done to farm lands adjacent to the rivers. In consequence there were many actions at law in the state courts which resulted in injunctions against the mines. Immediately prior to the general closing of hydraulic mining the annual yield is estimated to have been reduced to $5,300,000.[1]

Finally the decree of Judge Sawyer of the United States Circuit Court restrained the North Bloomfield Mining Company from discharging debris into the streams. This was in 1884. The court reserved the power to modify or suspend the injunction upon the defendant's showing that conditions had been so changed that the discharge of debris may be conducted so as not to continue the nuisance complained of. That is to say, hydraulic mining was not declared to be illegal, but the discharge of debris into the streams was forbidden. The provision of a dam to restrain the debris might make the necessary change in conditions to allow mining to be resumed.

Mine after mine was closed by injunction based upon this decision, and the federal legislation passed in 1893 (the California Debris Commission Act, or Caminetti Act) embodied the principles declared by these injunctions, but enacted more severe penalties for their nonobservance.

Present State of the Law.

The present state of the law is that hydraulic mining is illegal if carried on in such manner that it injures the navigable river channels of the Sacramento or San Joaquin river systems or the lands adjacent thereto; that the efficiency of a dam for restraining debris so that it shall not reach these channels is subject to approval by the Debris Commission, and a permit from that body is necessary before mining may be started.

---

[1] See Chas. S. Haley, "The Gold Placers of California." Bulletin No. 92, California State Mining Bureau, 1923, p. 16.

Gold Production and the Effects of Litigation and Legislation.

How much gold was obtained from hydraulic operations is not known, as the statistics that are available do not segregate the gold according to origin or method of production until the year 1897. Much gold was never reported and considerable sums may have been exported without being included in returns given by the mints, smelters, or express companies, to whom we are indebted for the only statistics of early years that are available.*

Lieut. Col. Mendell in his report of 1882 (Ex. Doc. 98) already quoted, gives a very complete account (pp. 22, 23) of all data that was available, and shows that from 1848 to December, 1881, the value of the known total production of gold from all sources in California was $1,178,000,000. Mr. Waldemar Lindgren in Professional Paper No. 73, already quoted, states (p. 81) that the production up to the end of 1909 amounted to between $1,200,000,000 and $1,500,000,000. Of this amount he considers that one-fifth came from quartz veins and the bulk of the remainder was from river gravels that were very rich and easily washed. The gravels that were higher in elevation and required hydraulic methods to treat them, and which geologists speak of as the tertiary gravels, he considers produced up to the end of 1909 about $300,000,000. A reliable estimate cannot be made for lack of data, and Mr. Lindgren calls this figure of his a "conservative guess". The gold production from all sources for 1880 (including the silver value that it contained) was $18,276,166,[1] according to Mendell's report.

Prof. J. D. Whitney in his Auriferous Gravels, written in 1879, says (p. 368): "The best authorities estimate the present yield from this source (hydraulic) at from $12,000,000 to $14,000,000,"[2] (per annum).

The Miners' Association estimated in 1881 that the annual gold production from hydraulic mining was between $11,000,000 and $13,000,000.

John Hays Hammond, writing in the IX Annual Report of the California State Mineralogist, 1899, said (p. 121): "The recent suppression of hydraulic mining by judicial decisions has reduced the annual gold product of California by at least $10,000,000 * * *"

The rapid fall in production from hydraulic mining after injunctions began to be issued has already been mentioned, and the present production averages only $122,114 (see p. 12).

---

* Years ago Wells, Fargo & Co. offered to the Mineral Resources Division of the U. S. Geological Survey all the receipts for gold bullion shipped through their agency from the beginning of gold mining in California. To work upon this mass of paper and produce therefrom a statement of yields from the individual mines would have required a staff of clerks for some months. Neither the Geological Survey nor the State Mineralogist office had funds to do this work and no prospect of obtaining funds for it. The papers were burned to get rid of them and thus perished much valuable data on the gold production of mines in California.

[1] Estimated by J. J. Valentine, Supt. Wells, Fargo & Co., see Mendell's Report, p. 23.

[2] Auriferous Gravels of the Sierras. Memoirs of the Museum of Comparative Zoology of Harvard; Contributions to American Geology, Vol. I, by J. D. Whitney.

Benefits That Were Intended for the Hydraulic Miner in the California Debris Commission Act.

The California Debris Commission Act was passed not only to protect farming lands and navigable rivers, but was also intended to assist hydraulic mining. The miners expected it to accomplish great things for them. It provided a nonpolitical body of army engineers whose duty it is to administer the act, survey the rivers for dam sites, erect dams when money was appropriated for them, and study and research "in divising a method or methods whereby such mining may be carried on as aforesaid" (Sec. 5).

To quote section 25 of this act in part:

> "Sec. 25. That said commission * * * is hereby directed and empowered, when appropriations are made therefor by law * * * to build at such points above the head of navigation * * * such restraining or impounding dams and settling reservoirs * * *."

The act further provides the rate of payment that shall be made for mining behind such restraining dams, the determination being made in a very simple and direct manner and at low cost to the miner. To quote section 23 in part:

> "Sec. 23. * * * the individual, company or corporation operating thereunder working any mine or mines by hydraulic process, the debris from which flows into or is in whole or in part restrained by such dams or other works erected by said commission, shall pay a tax of three per centum on the gross proceeds of his, their, or its mine so worked; * * *"

RESULT OF THE PRESENT INQUIRY.

Gravel Deposits That May Be Benefited.

Although no dams have been built by the Debris Commission as forecasted by this act, and although the production for 1925 was only $175,345 of which less than one-half was from the Grand Valley, there are some remarkably fine gravels that await the solution of the present difficulty—the provision of efficient debris impounding capacity at low cost.

In a report made to congress by the United States Corps of Engineers in 1891 (Ex. Doc. 267, p. 86) the gravel remaining in the Sacramento Basin and workable under the old conditions (*i.e.*, without restrictions as to dumping the debris) was estimated as 518,725,000 cubic yards; and a much larger amount if long tunnels and ditches were constructed to give access to ground not yet available—viz, 1,508,875,000 cubic yards, which is more than the amount already washed.

The restraining works at Daguerre Point were completed in 1910 but no moneys have been appropriated to enable the commission to build dams for the hydraulic miner. The matter has lain in abeyance in spite of official reports that such huge quantities of gravel are available, therefore this report deals only with those rivers where work formerly proceeded on the largest scale, and where water supplies are still available, viz: the Middle and South Yubas, Bear River, and the North and Middle American, all of which eventually discharge into the Sacramento River above Sacramento City. (See the map which accompanies this report and shows the locations of the gravels and of the various dams proposed.)

The most important reports already made to congress are Lieutenant-Colonel G. H. Mendell's reports of 1881 and 1882,* also the report of the Board of Engineers, made in 1891.**

The first two deal with conditions two or three years before injunctions were issued, and the last one reports conditions as they were six years afterwards. With these as a starting point the gravels have been visited, and conditions that affect them have been reviewed.

Preliminary investigations raised the hope that by utilizing these vitalizing provisions of the act, that is, by providing dams, hydraulic mining might be revived on the Yuba, Bear, and American rivers to an industry of considerable size.

Inspection of the more important gravels in these districts for the present Hydraulic Mining Commission showed that only 712,000,000 cubic yards could be regarded as workable under the changed conditions. A preliminary estimate of this amount was communicated to the Californa Debris Commission, February 15, 1926, and was as follows:

Preliminary Memorandum of Workable Hydraulic Gravels February 15, 1926, According to River Basins.

	Millions of cubic yards
North Fork American:	
Iowa Hill, Gold Run, Yankee Jim	115
Above Rice's Br. and N. Fork Br.	
Middle Fork American:	
Forest Hill, Michigan Bluff and Todd's Valley	30
Above Ruckachucky Canon.	
Bear River, with Greenhorn and Steep Hollow:	
Liberty Hill and Dutch Flat, Little York, You Bet, Red Dog, Chalk Bluff, Hunts Hill	43
Above Van Giesens and below Greenhorn Ck.	
South Yuba:	
Alpha, Omega, Sailor Flat, Blue Tent, Relief Hill.	
Above Edwards Br.	
N. Bloomfield, Malakoff, Lake City, N. Columbia, Esperence, Fr. Corral	415
Above Edwards Br. or Jones Ravine.	
Catch fines at Narrows.	
Middle Yuba:	
N. San Juan, Birchville, Badger Hill, Cherokee, Moores Flat	109
Above Emory Ford, Freemans Br. & Narrows.	
Total	712

This is a preliminary statement of gravel in place which can be handled by hydraulic mining, having sufficient grade and not being capped heavily by volcanic material.

ARTHUR JARMAN.

February 15, 1926.

For Mr. Egenhoff, California Debris Commission.

To mine this gravel it was recommended that dams would be required on the Middle and South Yubas, the Bear, and the Middle and North American rivers, in positions to be chosen from those shown on the accompanying map. Data on some of these sites were already available and the California Debris Commission sent their survey parties in the field to survey others. The results of this work have already been recorded.

---

*Known as Ex. Doc. No. 76, 46th Congress, 3rd Session, 1881, and Ex. Doc. No. 98, 47th Congress, 1st Session, 1882.

**Known as Ex. Doc. No. 267, 51st Congress, 2nd Session, by Lieut. Col. W. H. H. Benyaurd, Major, Thos. H. Handbury, and Major H. H. Heuer.

Estimation of Probable Rate of Working.

Totals for 20 years are given in Table I compiled from the estimated rate of working of the principal gravels on each river, the data being given at the end of the report for each river in turn. The yardage workable at each mine is calculated from the water available. Any increase in water supplies would increase the production beyond that given in the tables.

The rate at which gravel can be mined depends chiefly upon volume of water that can be run over the broken bank of gravel to carry it into the rockcuts and along the sluiceboxes. Good grade in rockcuts and sluiceboxes is more important for output than pressure at the nozzle, because it is the amount of material that can be transported out of the pit and down the sluiceboxes that actually determines the volume that can be mined. A bank of gravel can be broken down more rapidly than the gravel can be washed down the sluiceboxes. Cemented gravel can be shaken to pieces by the judicious use of powder when breaking down the bank, and moderate water pressure will give sufficient impetus to the jets to carry gravel into the cuts.

Justification of a Dam for Each River in Turn.

Considering each river separately we have at least one large gravel deposit which if proven to be profitable under the proposed conditions of resuscitation would by itself justify the erection of a dam so large that it would also serve other mines on that river. Judged in this way we may say that a dam that would serve the principal deposit for 20 years would serve all deposits on that river for 15 years, or something of this order, each case having to be worked out according to the deposits and the conditions.

This method of treatment has been followed, the "key" deposit on each river receiving most attention. It has been impossible to obtain data required for the smaller mines or portions of gravels to enable reasonably close estimates to be made, but approximate yardages were calculated for ground favorably situated so that no mechanical difficulties would prevent it from being worked. The ground considered to be payable has been restricted to ground that would be readily worked.

(COPY)

THE YUBA RIVER POWER COMPANY
725 Standard Oil Building, San Francisco, California.

January 29, 1927.

Hydraulic Mining Commission,
Ferry Building,
San Francisco, California.

Attention Mr. Arthur Jarman, Secretary.

Gentlemen:

The Yuba River Power Company is the owner of a comprehensive project for the development of the water resources of the Yuba River in the joint interests of the power, agricultural and hydraulic mining industries. This project comprises a series of power plants and reservoirs along the Yuba River and its North and Middle forks. The Bullards Bar unit was the first unit contracted under this project. The Yuba River Power Company has purchased certain lands for its various units, and the Federal Government has withdrawn in aid of the project the Federal lands necessary. This company also has applications before the Federal Power Commission and the Division of Water Rights of the State of California for the water and power rights pertaining to the additional units in the complete project.

Your Commission is interested in that phase of our development program covering the storage of debris from the operation of hydraulic mines. The construction of the Bullards Bar Dam has provided storage space for debris on the watershed of the North Fork of the Yuba River. Therefore, so far as the Yuba is concerned, it is now necessary to deal only with the South and Middle forks. This problem can be solved by the construction of The Yuba River Power Company's unit at the Narrows, near Smartsville, on the main river.

At present, our preliminary cost estimates on the Narrows unit have been made without actually drilling the dam site, nor have final figures been worked out as to revenues from power and irrigation and debris storage space, but preliminary estimates indicate that we can sell outright the 350,000,000 cubic yards of debris storage space for $1,500,000. This quantity is the actual cubical contents of debris storage space estimated to be available at the Narrows unit with a dam having its crest at elevation 520 feet above mean sea level.

In the meanwhile we will place at the disposal of the Hydraulic Mining Commission and the California Debris Commission, all data which is in our possession, and cooperate in every way and offer all facilities for such further investigation of this subject as are considered necessary. We consider it only fair that in return, any engineering data required by either of the Commissions should be made available to all parties concerned.

Very truly yours,

THE YUBA RIVER POWER COMPANY.
(Signed) By R. E. PHELAN, President.

R.E.P:R.

Copy to California Debris Commission.

Address Reply to
Secretary, California
Debris Commission,
85 Second St.

(COPY)

WAR DEPARTMENT

California Debris Commission,

San Francisco, California.

Refer to File No. 26761.

Subject: Preliminary estimates of proposed debris dams.

Mr. Lloyd L. Root,
State Mineralogist,
Ferry Building,
San Francisco, Calif.

Dear Sir:

Inclosed please find statement you have requested for the information of the California Hydraulic Mining Commission.

FOR THE CALIFORNIA DEBRIS COMMISSION:

Very truly yours,

(Signed) C. S. RIDLEY,
Major, Corps of Engineers,
Member and Secretary.

1 Incl.
(statement)

Estimates.

Following are preliminary estimates made up from data available at this time. The storage estimates are based on those considered necessary or desirable for 20 and 10 year periods of mining operations respectively and the assumption is made that the debris will stand on an average slope of 15 feet to the mile.

Twenty Year Period.

River	*Site*	*Storage, cu. yds.*	*Cost*
Middle Yuba	Freemans	51,000,000	$1,150,000
South Yuba	Nortons	70,000,000	3,090,000
South Yuba	Jones Bar	20,000,000	745,000
Bear	Lower Bear	21,000,000	310,000
North Fork American	Owl Creek	41,000,000	935,000
Middle Fork American	Mammoth Bar	22,000,000	125,000
Totals		225,000,000	$6,355,000

Ten Year Period.

River	*Site*	*Storage, cu. yds.*	*Cost*
Middle Yuba	Freemans	26,000,000	$545,000
South Yuba	Nortons	35,000,000	1,450,000
South Yuba	Jones Bar	13,000,000	420,000
Bear	Lower Bear	11,000,000	195,000
North Fork American	Owl Creek	21,000,000	470,000
Middle Fork American	Mammoth Bar	11,000,000	100,000
Totals		117,000,000	$3,180,000

The estimates for Freemans, Nortons, and Jones Bar sites are based on surveys made under direction of the California Debris Commission during the past year and are complete except that no subsurface exploration has been made of the dam sites. The estimate for the Lower Bear site is based on a combination of three surveys: One by U. S. Geological Survey in cooperation with the State of California, one by the California Debris Commission in 1905, and one by the California Debris Commission in 1924–25. It is believed to be reasonably close for preliminary estimates, but if construction work is contemplated, further check surveys should be made. No subsurface exploration was made at the dam site. The estimates for the Owl Creek site are based so far as the reservoir is concerned on data collected during the past year under the direction of the California Debris Commission. The reservoir site was taken from a private survey. No subsurface exploration was made at the dam site. The estimates for the Mammoth Bar site are based on two surveys: One of the area covered by the reservoir made in 1912 by the U. S. Geological Survey in cooperation with the California State Water Commission and published on a scale of 2 inches equals 1 mile; and the other of the reservoir site on a sketch map made under direction of Major W. H. Heuer. The nature of these data of course makes the above estimate of cost for this site only a rough approximation and if construction work is contemplated additional surveys are necessary. No subsurface exploration has been made at the dam site.

It will be noted therefore that borings are required at all of the dam sites before final estimates can be made or indeed before final decision can be made as to the practicability of dam construction at these sites. In addition to this further surveys are needed at the Lower Bear and Mammoth Bar sites.

GRAVELS OF THE NORTH FORK OF THE AMERICAN RIVER

NORTH FORK OF THE AMERICAN RIVER.

Estimates of Gravels on North Fork of the American River—Quantities in Millions of Cubic Yards.

Name of report	Whitney	Mendell	Board of Engineers	U. S. G. S.	This report
Engineer	(Pettee)	(Larson) Ex. Doc. No. 98	(Turner) Ex. Doc. No. 267	(Lindgren) Prof. Paper 73	(Jarman)
Year made	1879	1881	1891	1911	1926
Gold Run	86 to 125	18.48 1.21 on 95 acres only	46.0 on 555 acres	92	75
Iowa Hill—proper	23 to 24	6.38	28.7 to 30.0		8
Bird's Flat		7.26			
Momona Flat		4.06			
Roach Hill and Independence Hill		1.62			
Wisconsin Hill		5.08			Over 12
Gleason					
Big Dipper					
Forest Hill—North Side	No estimate	19.36		No estimate	*
Mayflower			12.0	No estimate	
Smith's Point			5.8	No estimate	
Georgia Hill			0.5	No estimate	
Lost Camp (Blue Canon)					10 claimed
Totals	109 to 149	63.45	93.0 to 94.3		Over 95

*Doubtful whether this would be worked.

Rate of Work Expected on North Fork of the American River and Production for First Twenty Years.

Mine or district	M.I.D. available	Duty	Per annum		For first twenty years	
			Yardage	Yield	Yardage	Yield
Iowa Hill	150,000	4	600,000	$42,000	12,000,000	$840,000
Gleason						
Big Dipper						
Gold Run	250,000	2	500,000	70,000 to 95,000	10,000,000	1,650,000
Forest Hill			Doubtful	if these would	be worked	
Lost Camp Mine at Blue Canon	*		50,000	7,500	1,000,000	150,000
Park and Brown Mine						
Totals	400,000		1,150,000	$119,500 to $144,500	23,000,000	$2,640,000
Average per annum				$132,000		

*Purchased, quantity variable.

In 1880 the total water used on the three forks of the American River was 1,914,500 M.I.D., with a duty of $4\frac{1}{2}$; this gave an annual yardage of 8,615,250. The duty would be lower than $4\frac{1}{2}$ because the gravel at Gold Run is middle and bottom gravel, all top stuff having been removed.

GOLD RUN.

North Fork of the American River.

The Gold Run gravels are the key to the case for the North American River. The deposit extends from Indiana Hill on the south to Dutch Flat on the north, a distance of four miles. The width of the gravel varies from 600 to 1000 yards and averages over one-half mile. More than half of this ground is on the south side of the ridge along which runs the railroad. Most of this is under one ownership, having been consolidated in 1911, and would be economically worked in consequence. It is on the south or American River side of the ridge that separates the North Fork American from the Bear River. The length of channel is 4053 yards; this has an area of 1,401,180 square yards leaving out of account gravel too far to one side or too high on rims to be worth while attacking.

Photo by Ernest A. Bailey,
Field Engineer, Sacramento.

STEWART GRAVEL MINE AT GOLD RUN.

View looking north, showing the pit of the mine with the slate bedrock exposed and the rock cuts in it. The extension of this pit by future hydraulic work will create a reservoir useful for water conservation and the development of power. Debris will be restrained by a dam on the North Fork of the American River.

Starting at the south end of this ground, at Indiana Hill, the bedrock has been washed clean for about 330 yards along the channel, then there is a body of bottom gravel 40 to 60 yards deep occupying the channel for 220 yards this has been tunneled and drifted. Immediately north of this gravel is the old Indiana Hill pit: the bedrock here was washed clean for 550 yards along the channel and for a width of 700 yards. In both pits the bedrock slate is very gently dished, being the floor of a glacier. Banks of gravel were left on the sides or rims of this channel and under them the rock rises sharply. At the north end of Indiana Hill pit the gravel has been drifted; the main tunnel was driven 553 yards along the channel, most of it at a few feet above bedrock. This makes 1633 yards of channel explored by drifting or exposed by hydraulicking.

Up to this place on the channel the amount of gravel is calculable and is 27,436,000 cubic yards, the depth of gravel being known from surface survey and from the known bedrock positions. It is 2420 yards from this point to the railroad or north end; the gravel surface is known but bedrock is not exposed again until Dutch Flat is reached, when it is found to have risen about 100 feet in 4 miles of channel. There are no surface indications of faulting. This section of gravel therefore has bedrock with a grade of about 25 feet per mile and similar to that exposed by workings in the south end as already described. As the gravel is wider here, it is expected that the bedrock will be flatter than before, as is usual in these gravels of the Sierra. Knowing the elevation of the gravel surface and deducing the position of the bedrock in this manner, we have depths of gravel in the center of the channel from 66 to 80 yards.*

As these depths are applied to calculate the yardage for a considerable length of channel (2420 yards) and an area of 895,400 square yards, I have assumed as a factor of safety that the bedrock is dished or curved instead of almost flat.

If the bedrock were horizontal right across, the cross-section would be rectangular and we should have 62,672,000 cubic yards but with the channel of curved cross-section we obtain about 47,500,000. Add this to our previous figure of 27,436,000 and we have the total of approximately 75,000,000 cubic yards as the gravel available and workable if gold contents are satisfactory.

The Table on page 41 gives other estimates for the purpose of comparison.

Values in the Gold Run Gravels.

In the absence of sampling by prospecting shafts or other openings in the unworked gravels, it is necessary to use what past records are available. Unfortunately these are only of a fragmentary nature due to the fact that Mr. Jas. D. Stewart's library and papers were burned when his residence was destroyed by fire at Auburn, in 1916.

The top gravel washed in early times has gone, being washed off along the whole length of the channel except for the narrow strip under the railroad and highway, and some rim gravel out on the sides, that is not included in this estimate.

The old accounts of this top gravel must be considered as they are apt to be quoted, though they do not represent the deeper gravel that remains.

Whitney, p. 147, records the following estimate made by W. H. Pettee in 1879. Between the railway and the southern end an area of 427 acres had been worked and his measurements showed 43,000,000 cubic yards were washed off. Returns from the banking house of Messrs. Moore and Miner at Gold Run, from March, 1865, to October, 1870, showed bullion shipped $1,385,280.55. Much gold was known to be shipped by other routes and he ssumed $615,000 of gold sold elsewhere, giving a total of $2,000,000 approximately, which gives a value of 4.65 cents per cubic yard. This was mostly top gravel.

---

*These depths were ascertained by Mr. J. D. Stewart by surveys.

He remarks that this amount of gold per cubic yard falls much below the estimates of miners and claim owners.

E. Call Brown, consulting engineer of Los Angeles, reports that between 1856 and 1882, five properties in this district bought an aggregate of 10,000 miner's inches of water per day at 50 cents per 24-hour inch*

Ross E. Brown,** in 1867 reports that these mines paid $1,000 per day for 9000 miner's inches (or 11 cents per miner's inch). Raymond, in the same series, 1875, p. 102, says the water rates in this district are 12½ cents per inch per 24 hours. It does not seem likely that old time miners were washing 5-cent gravel with such expensive water, even though the surface gravel at Gold Run had the reputation of being very easy to wash.

Waldemar Lindgren (Prof. Paper No. 73, p. 45) says "the yield per cubic yard of hydraulic gravel is said to be 11 cents." Lindgren is cautious in all his statements, and though he gives this value in a tentative manner, he does not even mention the lower figures given by Pettee. It may be that this gravel, very close to surface, was low in value, as at Bloomfield and Columbia Hill or North Columbia. Lindgren says 84,000,000*** cubic yards had been washed away. This is 41,000,000 more than Pettee's estimate, so that the gravel then being washed would be deeper and richer.

Mr. Jas. D. Stewart worked at Gold Run as a youth and later acquired control of this property. His father was superintendent of Gold Run for years. He says that large quantities of gold were shipped direct to the mint or to Selby smelter to obtain full value for it.

The top gravel has been washed off this deposit for a depth of 40 to 80 yards, this latter being the height of the ridge of gravel left to carry the railroad and highway. Near this bank in 1905 and 1906 some twenty Chinese washed some fallen gravel. They paid $10,000 gold for the lease, also paid $5,400 for water to wash it and were well satisfied with the results obtained. From a consideration of the water used and its probably duty, Mr. Stewart estimated that this gravel yielded 20 cents per cubic yard.

Value of Undrifted Hydraulic Bottom Gravel (Cemented) at Gold Run.

The following is the account of a gold bar obtained from work in June and July, 1908, on a bank of gravel 80 feet high that had not been drifted. This is the only bulk sample that we have record of.

Date: August, 1908—Weight of bar 3257.91 oz. Value $64,564.81. Gold fineness 902.
Obtained from 15 head boxes and undercurrent. The lower boxes were not cleaned up.
Height of bank: 80 feet.
Water used: 2000 miner's inches at 450 feet head.
Duration of run: 60 days of 24 hours each.
35 men employed.

---

* I have not been able to find any direct confirmation of this statement.

** Resources of the United States West of the Rockies, 1867, p. 101.

*** This is probably a quotation of Turner's estimate (see the Table on page 41).

Powder used: 5500 kegs of 25 lbs. each.
Dynamite used: 7500 lbs. of 40%.
237,400 cubic yards of gravel washed by actual measurement of the bank by surveyor.
This is equal to **27.2 cents per cubic yard.**
Duty of the miner's inch 1.98 cubic yards.

Value of Drift Gravel of Bottom Ground at Gold Run.

Drifting operations in 1906 gave values shown by the following table. Each car held about 16 cubic feet of gravel which would be equivalent to about 27 cubic feet or one cubic yard of gravel in place, as the boulders were stacked behind in the working places.

Date	Quantity	Production	Dollars per cubic yard	Remarks
Apr., 1906	301 cars	$1,595 81	$5 30	Drifting above bedrock.
May, 1906	207 cars	504 00	2 43	Going north.
June, 1906	129 cars	120 50	0 94	
Oct., 1906	392 cars	1,590 71	4 06	
Nov., 1906	472 cars	1,933 00	4 10	Half of this was on bedrock.
Jan., 1907	122 cars	355 00	2 91	
Feb., 1907	165 cars	1,293 92	7 85	
Totals	1,788 cars	$7,392 94		

Average $4.13 per car or per cubic yard of gravel in place.

The above data enables us to obtain some idea of the value of the gravel hydraulicked immediately above the bottom drifting gravel. The drifts would be about 2 yards in height, so we calculate as follows:

Calculation:

80 yards of gravel at 27.2 cents	2176 cents
2 yards drifted at 413 cents	826 cents
78 yards hydraulic gravel would carry	1350 cents

This is at the rate of 17.3 cents per cubic yard.

From the 1600 foot tunnel 4375 cubic yards were taken that yielded $9,578.60 or $2.24 per cubic yard; over half of this material was two to seven feet above bedrock. This is from ground that will later be hydraulicked.

The following particulars are given by Mr. Stewart from his personal recollection or from notes: The Cement Mills Company mined 80,000 cubic yards of gravel by drifting under Indiana Hill at the south end of the property and it yielded $750,000 which is over $9 per cubic yard. The General Thomas Placer Mine on Indiana Hill produced $150,000 from 17,100 cubic yards of gravel mined by drifting; this is over $8 per cubic yard. These returns are interesting but they represent gravel at the south end of the property and therefore away from the direction of future work.

The Indiana Hill Placer Mine was one of over twenty that were working in the big pit mentioned on p. 42. Mint returns for three seasons show the following figures for this one mine:

1876	$ 24,091.68	
1877	19,636.35	
1878	93,784.96	
1879	14,712.91	—this last figure was for the January clean-up only.
Total	$152,225.90	

Value of Gravel Remaining to Be Hydraulicked.

Summarizing the foregoing statements: The first gravel washed was light surface material and Pettee estimated it at 4.65 cents per cubic yard; **this has all gone.** The next 40,000,000 cubic yards is reputed to have been 11-cent material as already quoted. The cemented gravel below this may be up to 80 feet thick and carry 17.3 cents per cubic yard, with drifting gravel below that carrying $2 to $4 per cubic yard, if it has not already been drifted.

Question: To what extent are we justified in applying these values to the gravel remaining? They apply to the 27,436,000 cubic yards remaining on the southern part of the property, that being where this hydraulic and drift work was done. This yardage at from 11 to 17 cents without counting undrifted bottom gravel that would raise the returns above 17 cents constitutes a very fine mine. Beyond this, at the northern end, work stopped for lack of grade, tunnels being required from Canon Creek at the lower end to give grade. These tunnels are now available because of the consolidation of the properties into one, and would suffice to work a large area, but an additional tunnel would be required for the extreme north end. This north end, estimated to contain 47,600,000 cubic yards, should pay well under the new conditions as there has been no drifting done on it. The only way to tell whether there will be more or less gold than at the south end is to work it or put down trial shafts for sampling tests.

Storage is required and is justified for whatever amount can be worked in twenty years or the period considered. The first 27,000,000 should yield from 11 cents to 17 cents per cubic yard and the remainder should exceed these values as no drifting has been done in that area.

Water Available and Rate of Work Expected.

Upon this will depend the storage required for the first twenty years. The amount expected to be mined in other deposits on the same river must be considered also.

> 1600 miner's inches from Rattlesnake Ditch, giving 400 feet of pressure head.
>
> This flow is maintained for five to seven months, the water coming from Canon Creek through 5 miles of ditch.

Total water for 5 months each of 26 piping days=1600x5x26=208,000 M. I. D.

Total water for 7 months each of 26 piping days=1600x7x26=291,200 M. I. D.

Average: 250,000 M. I. D. for the season.

To work this property to the best advantage a larger supply of water should be developed for a longer season.

The upper gravels at Gold Run gave high duty per miner's inch, the middle gravel is slightly cemented but crumbles readily when the bank falls or is shaken by powder blasts, and the bottom gravel is more strongly cemented. We, therefore, cannot use a high duty in calculating yardage expected to be moved.

The duty of 1.98 already recorded was from bottom gravel that was cemented and required crumbling by blasting. There is some bouldery material that would give a lower duty, but there is also medium gravel that would give a higher duty. An average of 2 may be expected and has been used for the purpose of this estimate: 250,000x2=500,000.

Gold Output Expected.

The bottom gravel that has been drifted would yield 17 cents and if undrifted, up to 27 cents.

The middle gravel would equal the general estimate of 11 cents, mentioned by Lindgren.

The mean of 11 and 17 is **14 cents** and the mean of 11 and 27 is **19 cents** and at these figures 500,000 cubic yards would produce from $70,000 to $95,000 for the season. Drifting has proceeded along the channel as described, but not always on bedrock, and breasting has not been carried right across the channel. The returns in undrifted ground may exceed 19 cents.

In 20 years 10,000,000 cubic yards could be worked with the present water supply and produce $1,400,000 to $1,900,000. In the table a mean figure of $1,650,000 has been used.

The development of additional water will enable this output to be exceeded without difficulty. There is plenty of gravel workable with the present tunnels.

Other Mines on the North Fork of the American River.

IOWA HILL.

The ground upon which the town stands is a narrow ridge, the gravel having been washed away from it on both sides. It is unlikely that the houses at Iowa Hill would be removed to enable gravel to be worked as most of them are occupied.*

There are some banks of gravel left without lava cover, but in many places the work proceeded up to and under heavy thicknesses of barren volcanic material. These places would be unlikely to be profitable under present conditions.

At Independence Hill the face of the gravel bank on the north side shows a large trough that has been filled with andesite and tuffs. Roach Hill was worked until the cover of andesite was very thick. On the south bank of Indian Creek there is a succession of hydraulic pits that form an almost continuous coastline for a length of two miles. In some places these pits do not go far into the bank but at the Morning Star claim work was stopped by the thickness of the cover; drifting then proceeded for years and in 1899** connected with drifts from mines at Wisconsin Hill 3000 yards away. There, from pits of the Gleason, and the Waterhouse and Dorn or Big Dipper, a very large amount of gravel was removed, but a large amount of bottom gravel was left at the latter mine. These banks show a readily washed gravel, with no lava capping, there being over 12,000,000 cubic yards readily available in the immediate vicinity of the pits. As drifting operations have proved that this gravel passed through to the Morning Star side it should be workable with profit until the lava cover becomes too thick, and this figure may be exceeded. Previous returns show 5 to 7 cents per cubic yard but good profit was made because of the high duty per cubic yard.

---

* Many of these old mining towns were built upon good gravel, sometimes on the best part of it, right in the center of the channel: Iowa Hill, Little York, St. Louis, Wisconsin Hill, Michigan Bluff, Dutch Flat, Relief Hill, Omega, You Bet.

** Lindgren, p. 149.

In the table Iowa Hill and Wisconsin Hill together are credited with 20,000,000 cubic yards of workable gravel that should pay. If a dam be provided upon the North Fork American River at Owl Creek or some lower position these deposits would be worked because there is no large power or irrigation project using the water. Most of it is still available for mining.

Mr. I. E. Rose, part owner of the McGeachin Placer Mining Company (owning the Big Dipper Mine) surveyed this property in 1915 to determine the hydraulic gravel available. He estimated that 7,000,000 to 8,000,000 cubic yards had been washed away and 32,000,000 could be washed without trouble from overburden, and another 6,000,000 with overburden, making 38,000,000 in all. He estimated that it would contain 12 cents per cubic yard. The Gleason Mine adjoining it has had about 25,000,000 cubic yards washed away and would yield another 5,000,000. Previous operations here yielded about 15 cents per cubic yard.

In 1880 the mines at Iowa Hill used over 133,000 M. I. D. Very little water has been taken up for power and a larger amount could be developed for mining. The bottom gravel is partly cemented but would give a duty of 2, and the upper gravels a very much higher duty. In the IX Report of the California State Mineralogist, Mr. John Hays Hammond reported the duty obtained at the Hobson mine as 24 cubic yards per M. I. D. using 12 inches grade for a 12 ft. box. Cemented gravel gave a duty of 10. At Wisconsin Hill using the same grade in the sluices a duty of 10 was obtained, and 3 on cemented gravel.

Probable Yardage and Yield for the Season.

Calculating on 1000 miner's inches for a season of 150 days and an intermediate duty of 4 we should obtain a season's yardage of 150,000x4=600,000 cubic yards. The district as a whole should readily attain this.

The second report of the State Mineralogist (1882) gives the yield from some of these gravels in some Notes on Hydraulic Mining by E. W. Robinson, page 170.

The Morning Star Mine gave 37 cents per miner's inch and moved 5.61 cubic yards per miner's inch. This is equivalent to 5.6 cents per cubic yard.

The Orion yielded 50 cents per miner's inch and moved 10.19 yards, which is equivalent to about 5 cents per cubic yard of gravel.

The Sailor's Union Hydraulic Mine yielded 10.7 cents per cubic yard and the Vaugh claim 34 cents (Whitney p. 117). In most cases there is no reliable record of the values. It is probable that the yield would be much greater than 5 to 7 cents, as the Big Dipper was not worked to bedrock at that time.

The Lost Camp Mine in Blue Canon would be benefited by a dam in the North Fork American River. It was worked in 1916, using water purchased from the Pacific Gas and Electric Company at 10 cents per M. I. D. (see Mines and Mineral Resources of Placer

County, California State Mining Bureau, Dec. 1916, p. 106). The Park and Brown Mine would also work on this river using water from Deep Creek, (see the same report, p. 107).

FOREST HILL.

In Lieut. Col. Mendell's report of 1881, Ex. Doc. 98, p. 109, Andrew Larson, giving an estimate for Forest Hill, northern part, says: "This part was most difficult to estimate because it is all covered with lava, excepting a very small space, and the hydraulic working depends upon how far the lava material keeps soft; when it gets to be rocky or hard the hydraulic mining is finished. He allowed a possible 19,560,000 cubic yards."

The 1891 report of the Board of Engineers (Ex. Doc. No. 267, p. 85) estimated that 6,000,000 cubic yards are available, and with tunnels 12,000,000 might be developed. For Smith's Point and Yankee Jim's, 3,000,000 to 5,800,000. These mines on the north side of the Forest Hill Ridge discharge into Shirttail Canon, which joins the North Fork American above the site most favored for building a dam. Unfortunately there is little likelihood of hydraulic work on this side of the ridge, although previous reports say that there would be some.

Yankee Jim deposits are finished; Georgia Hill on the other side of Devil's Canon has been worked inwards until one-half of the bank shows andesite capping as thick as the gravel, and the cover on the other half will increase rapidly. Nevertheless, residents of Forest Hill expect hydraulic work to be done here. Smith's Point, east of Yankee Jim's, shows two spurs of gravel that would be easily washed in continuance of old work, but this is not where values seem to have been high. The greater part of the hydraulic work was carried on along the run of a well defined channel until the andesite cover was very thick. This is shown in two pits. At the Mayflower a lot of shallow hydraulicking was done, large areas of top gravel were removed until a layer of tuff was met that seemed to form a good substitute for bedrock for washing operations. A large pit was thus formed round the site of the Mayflower shaft and also in other places.

I have not counted on any yardage from these places, but if work started the debris produced would be accommodated by a dam on the North Fork American River at the Owl Creek site on the North Fork site.

Forest Hill was carefully surveyed and reported upon by Ross E. Browne in 1890, see X Report of the California State Mineralogist, and by John Hays Hammond in 1889, see IX Report of California State Mineralogist, p. 105.

An excellent map of the district was published with that Report, likewise one of the Iowa Hill field.

Forest Hill is essentially a drift mining district. Its mines have been rich, and the map shows mining claims at the old town on the south side of the ridge below the present town, narrower than those on any other field. The ability to hydraulic for a while to uncover the bedrock and determine the run of the channel may be of great assistance to subsequent drifting. This makes it simpler to determine where bedrock tunnels should be started in order to arrive under the center of the channel and have enough grade.

LOST CAMP.

This mine in Blue Canon was not inspected. It has been worked with water bought from the Pacific Gas & Electric Company's ditch at 10 cents per M. I. D.*

10,000,000 cubic yards are claimed to be available. Debris is restrained by a wire basket fill dam. To pay when worked in the above manner, the contents probably average 15 cents per cubic yard.

Annual yardage would depend upon water available over and above the needs of the Pacific, Gas and Electric Company.

50,000 cubic yards at 15 cents=$7,500.

In 20 years the output would exceed $150,000, probably by a large amount, dependent chiefly on water available.

---

*See also Mines and Minerals of Placer County, California State Mining Bureau, Dec., 1916, p. 107.

MIDDLE FORK OF THE AMERICAN RIVER

MIDDLE FORK OF THE AMERICAN RIVER.

Estimates of Gravels on Middle Fork of the American River—Quantities in Millions of Cubic Yards.

Name of report	Whitney	Mendell	Board of Engineers	U. S. G. S.	This report
Engineer	(Pettee)	(Larson) Ex. Doc. No. 98	(Turner) Ex. Doc. No. 267	(Lindgren) Prof Paper 73	(Jarman)
Year made	1879	1881	1891	1911	1926
Forest Hill, South Side	No estimate	No estimate	....	No estimate	....
Paragon (Bath)	No estimate	No estimate	24.5	....	Over 15
Dardanelles and Baltimore	No estimate	No estimate	5.5	No estimate	Over 3
Todd's Valley and Spring Garden	No estimate	No estimate	5.0	No estimate	Nil
Michigan Bluff	No estimate	No estimate	....	....	....
Big Gun	No estimate	No estimate	23.1	No estimate	Over 3
Sage Hill	No estimate	No estimate	....	....	Not estimated
Totals	....	....	58.1	....	Over 21

Rate of Work Expected on the Middle American River and Production for the First Twenty Years.

Mine	M.I.D. available	Duty	Per annum		Twenty years	
			Yardage	Yield	Yardage	Yield
Forest Hill, South Side:						
Paragon (Bath)	110,000	4	440,000	$44,000	8,800,000	$880,000
Baltimore and Dardanelles	40,000	2	80,000	10,400	1,600,000	208,000
Michigan Bluff:						
Big Gun	72,000	2	144,000	12,960	2,880,000	259,200
Sage Hill	Not estimated	....	....	....	....	....
Totals	222,000	....	664,000	$67,360	13,280,000	$1,347,200

Middle Fork of the American River.

MICHIGAN BLUFF.

The Big Gun. In this district there is the Big Gun mine with 400 miner's inches available. For a season of 180 days this gives 72,000 M. I. D. One bank of gravel here contains over 2,000,000 cubic yards. There is also the site of the old town which was built on gravel. Only the bottom gravel is cemented and the duty obtainable would be 2 or more. This mine is mentioned in Ex. Doc. 267, p. 93, as difficult to work (the reasons are not given) and as having been sold to satisfy judgments. Nevertheless it is still fitted up to work (1926) and negotiations are under way for working it again. The yield of the gravel is not recorded, and it has been assumed as 9 cents per cubic yard. The ground falls rapidly to the river so that grade would not be difficult to obtain.

Keokuk Point, about 1 mile west of this has been completely worked off and the bedrock cleaned.

Sage Hill, two miles to the west shows gravel on several points or spurs jutting out into the canyon of Birds Valley. These deposits are irregular and so much overgrown that no estimate of quantities was possible. Some hydraulic prospecting was being carried on.

South Side of Forest Hill.

Mines on the south side of Forest Hill drain into the Middle American River.

Baltimore and Dardanelles. At the Dardanelles there is a bank of gravel left because the reservoir was above it. To the east of this the Baltimore has a point on which there is estimated to be at least 2,000,000 cubic yards. The Dardanelles formerly yielded 13 cents per cubic yard.* This gravel is cemented but would wash readily at a duty of 2 after blasting. 48,600 M. I. D. were used in 1880. Much more would be available if the ditches were cleared.

The Paragon Mine at Bath (also called the Breece and Wheeler) could easily be fitted for work and has two ditches, the Tod's Valley or Pond ditch with 600 miner's inches from Volcano Canon and the Breece and Wheeler Ditch with 1500 miner's inches from Eldorado Canon; 113,500 M. I. D. from these streams were used on this side of Forest Hill in 1880. No water has been taken for other purposes on this ridge, and more water would be available as the mines on the north side of Forest Hill would not be using it, but the ditches would need clearing. From 1874 to 1879 this mine was worked by hydraulic method only and produced $243,075.87 from which dividends were paid amounting to $119,670.14. This yield of gold equalled $2.54 per miner's inch of water used, a high return (see Ex. Doc. No. 98, p. 24). The IX Report of the California State Mineralogist records that a bank of gravel 70 feet high gave 74.2 cents per cubic yard 124,000 yards yielding $92,000.00. Another bank 71 feet high gave 78 cents per cubic yard, 22,275 yards yielding $17,387.78.

When hydraulic work was stopped, this mine was drifted at the bottom or Blue Lead and also on a richer pay streak called the Paragon 160 feet above bedrock and a third streak called the Orono; from these it gave regular returns.

As a result of this drifting, future hydraulic results would be lower. The bottom gravel contains many large boulders, some being granite. The ordinary gravel contains pebbles stained green with chlorite, which the miners say is a very favorable indication for gold.

Above the gravel there is a cover of tuffs and then andesite. This would reduce the returns, but the andesite has been eroded so that the amount of cover would not increase much for 100 yards of work behind the present bank. Gravel miners consider this mine is rich, but the barren cover must be moved. When drifting had been carried on for 3850 feet, a barren channel filled with volcanic material was encountered (Whitney p. 94). Drifting was done over a width of 200 to 300 feet and the trough was stated to be 4000 feet wide.

About 15,000,000 cubic yards could be worked without trouble from the andesite cover. The yield is difficult to forecast. In many districts the old miners piped away the overburden and lighter top gravel and got rid of it as fast as possible. Having done this they prepared to pipe the "gravel" and if they estimated the quantity of gravel piped or the returns from a bank it was usually "pay gravel" that they considered. Top stuff was only cover or surface material, not worthy of consideration. A bank of 70 feet carrying 76 cents per cubic yard, covered with 100 feet of light gravel probably 15-cent material, and 200 feet of barren tuffs and andesite which the bank now shows would average 18 cents per cubic yard for the whole bank. Ten cents has been used for this calculation because the large amount of drifting that has been done would reduce the former values considerably.

---

*Ex. Doc. No. 98, p. 23.

Assuming the ditches to have half capacity there would be 1000 miner's inches, and a season of 180 days would give 180,000 M. I. D. In 1880 there were 113,000 M. I. D. used in this district. 110,000 M. I. D. has been assumed and a duty of 4 (there is plenty of grade and $\frac{2}{3}$ of the bank is easy to move).

The season's work would be:

110,000x4=440,000 cubic yards,

and the yield would be:

440,000x10c=$44,000.

The production of this mine when hydraulicked was about $55,000 per annum.

BEAR RIVER

BEAR RIVER.

Estimates of Gravels on Bear River (Including Greenhorn and Steephollow —Quantities in Cubic Yards.

Name of report	Whitney	Mendell Ex. Doc. 98	Board of Engineers Ex. Doc. 267	U. S. G. S. Prof. Paper 73	This report
Engineer	(Pettee)	(Larson)	(Turner)	(Lindgren)	(Jarman)
Year made	1879	1881	1891	1911	1926
Lowell Hill		None	1,200,000		
Liberty Hill		1,645,600	6,000,000 to 10,000,000	16,000,000	Over 4,500,000
Elmore Hill and Nary Red		Nil			?
Dutch Flat:					
Polar Star Channel					4,710,000
Gold Run Channel	No estimate	8,500,000	30,000,000 to 36,000,000	Much less than 90,000,000	17,286,000 to 34,573,000
Christmas Hill	No estimate	605,000	1,500,000		Over 440,000
Little York	No estimate	484,000	1,600,000	Nearly finished	Over 3,000,000
You Bet (including Red Dog, Nevada, Niece and Wests, Brown Hill)		9,680,000 4,840,000	30,000,000 to 75,000,000	100,000,000	20,000,000
Walloupa		(Sailor Flat)			
Chalk Bluff		4,840,000			Too cemented
Buckeye Hill			4,000,000 to 5,200,000	Nearly finished	
Hunts Hill (or Gouge Eye)		2,420,000			Over 5,000,000
Quaker Hill		16,262,400	90,000,000	140,000,000	
Remington Hill		484,000	1,000,000 to 6,000,000		
Excelsior Point					
Pleasant Hill		58,080			
Wolf Creek Basin			100,000 to 500,000		
Totals		49,819,080	121,100,000 to 227,000,000		Over 32,940,000

Rate of Work Expected on Bear River and Production for First Twenty Years.

Mine	M.I.D. available	Duty	Annual		Twenty years	
			Yardage	Yield	Yardage	Yield
Lowell Hill and Liberty Hill	275,000	1½	350,000 to 525,000	63,000 to 94,500	7,000,000 to 10,500,000	1,260,000 to 1,890,000
Foss	30,000	2	60,000	5,400	1,200,000	108,000
Little York and Christmas Hill	75,000	2	150,000	22,500	3,000,000	450,000
Elmore Hill, Dutch Flat, Polar Star, Southern Cross, Jehoshaphat, etc.	*	1			†	
You Bet, Brown's Hill, Walloupa, Red Dog, Nevada Hydraulic	380,000	1½	570,000	85,500	11,400,000	1,710,000
Hunt's Hill, Quakers Hill	54,000	2	108,000	16,200	2,160,000	324,000
Totals	760,000		1,238,000 to 1,413,000	192,600 to 224,100	24,760,000 to 28,260,000	3,852,000 to 4,482,000
Average			1,325,500	$208,350	26,510,000	$4,167,000

*Purchased from P. G. E. Co. ditch or developed from other sources.

†Output not calculable until water available is known.

In 1880 the total water used for hydraulic mining on Bear River was 1,117,082 M.I.D. which was estimated to have duty of 3, giving an annual yardage of 3,351,246. There was a large volume of top gravel in this, the yield from which would be low.

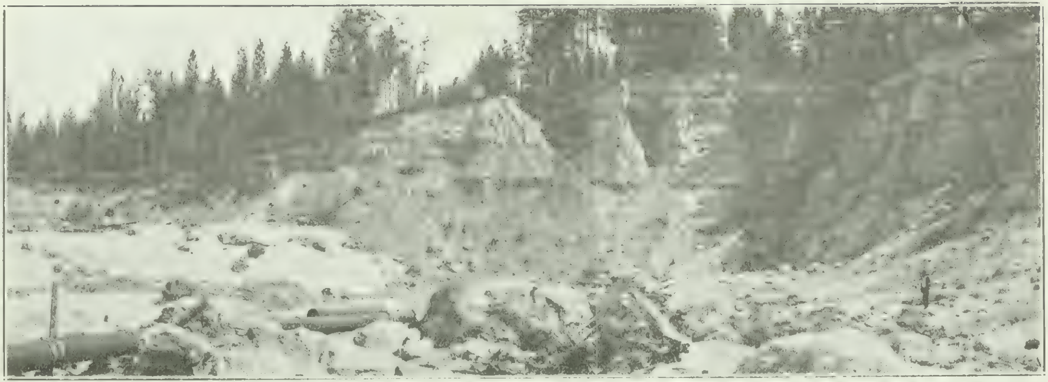


Photo by Arthur Jarman.

LIBERTY HILL MINE, ON BEAR RIVER.

This mine has worked intermittently since the injunctions, debris being caught in a log crib and rock-fill dam opposite Dutch Flat. The dam has been raised from time to time to increase its capacity. A concrete dam will enable steady work to proceed on all mines on that river.

BEAR RIVER.

Liberty Hill and Lowell Hill.

A channel from Lowell Hill runs through Liberty Hill, crosses Bear River to Elmore Hill, then crosses Little Bear Creek to the Polar Star Pit and thence joins the main channel at Dutch Flat. The gravel is readily traced over this country. At Lowell Hill much drifting has been done and some hydraulic work.

Swamp Angel Mine.

Some preparations were made to hydraulic in 1921 and 1923 but the small concrete dam built for this purpose became filled with tailings brought down by freshets.

Foss Mine.

Preparations are under way for hydraulic work. The owners claim to have a large yardage on this channel and propose to use 30,000 M. I. D. per season at the commencement of hydraulic work. The mine was not visited.

Liberty Hill Mine.

Liberty Hill is southwest of this and has been worked from time to time since injunctions obliged the miner to provide dams. There is a log crib and rock fill dam below Little Bear Creek on the Bear River which is used by this mine. A report by P. D. Burt made in 1916 estimated that 8,000,000 cubic yards was available that should yield 16 cents per cubic yard.

Reporting in 1925, L. A. Decoto estimated the gravel as averaging 19 cents per cubic yard, the top gravel giving a duty of 2 and the bottom a duty of one-fourth yard per miner's inch. The top material is easy to move and should do better than this, but the bottom gravel is often so cemented that it must be shattered by powder before attacking it by water. Various estimates have been made of the quantity of gravel that remains. The owner of the Liberty Hill Mine estimated 4,500,000 cubic yards on his ground alone.

Ex. Doc. 267, p. 85 estimates 6,000,000 to 10,000,000 cubic yards. Lindgren quotes 16,000,000 as remaining. The bank is only 40 to 80 feet high and about 600 feet width of channel is worked. This would mean 4,000,000 cubic yards in the next 1000 yards of channel.

The gravel appears to be continuous to Lowell Hill, a distance of about 4000 yards, all covered by timber. Six shafts put down near the rim to determine the width of pay channel are reported by Mr. W. Maguire to have averaged 14 cents per cubic yard., Three shafts were sunk ahead of the pit to determine the continuation of the channel and its values. Two have since been worked out.

The owner of the mine (Mr. W. Maguire of Nevada City) submitted figures showing that the mining of 1,200,000 cubic yards of gravel produced $210,000 between the years 1896 and 1915. This is at the rate of 18.3 cents per cubic yard. The last work was in the season 1920-1921 when W. S. Bliss washed 131,049 cubic yards of top gravel for a return of $18,192.81 and the glacial gravel underlying it was afterwards blasted and piped, 21,500 cubic yards giving a return of $17,526.61. These quantities of gravel were determined by survey by Mr. Uren. This is at the rate of 13.88 cents for top gravel and 81.5 cents for bottom gravel, and 23.4 cents average for the whole bank.

Rate of Work Possible.

2000 M. I. of water are available for a season of about 150 days and after that 500 M. I. for another 100 days.

150 x 2000=300,000 M. I. D.
100 x 500= 50,000 M. I. D.

Total-----350,000 M. I. D.

At a duty of 1 to 1½ cubic yards per M. I. D. this gives 350,000 to 525,000 cubic yards of gravel for the season. At 18 cents per cubic yard this would yield from $63,000 to $94,500.

Dutch Flat.

The channel from Liberty Hill crosses Bear River to Elmore Hill and Nary Red.* At the latter place hydraulic work has proceeded in several pits, the light surface gravel has been washed off, and some of the heavy gravel below it, exposing slate bedrock. The bank has been drifted. At Elmore Hill only the light upper gravel has been washed off. This hill is a direct continuation of the channel which can be seen to cross Bear River from Liberty Hill; from Elmore Hill it crosses Little Bear River and is seen on the opposite bank in the Polar Star Pit and so it passes on to Dutch Flat. All this area on the Dutch Flat Side (or south side) of Bear River would have to purchase water unless some new source of supply could be developed.

This fact coupled with the heavy nature of the bottom gravel and its cemented character makes future operations doubtful.

Polar Star.

This mine worked down to bedrock, as did the Southern Cross in one of its pits. The bottom gravel is 60 to 90 feet thick and is glacial, with large boulders and strongly cemented near the bedrock. Some of the boulders are over 10 feet in diameter. Figures given by W. H. Pettee showed that the top gravel yielded 11 cents, (Whitney p. 425). W. Nichols who owned and operated the Polar Star and Southern Cross up to and during the trouble with injunctions, figures that this gravel yielded 25 cents after having been drifted, the bottom portion yielding 40 cents.

The water used in the last work done here was purchased from the Pacific Gas and Electric Company's ditch and cost 10 cents per M. I. D. It is an open question whether this heavy bouldery cemented gravel would pay to work under present day conditions with water at this price. When washing heavy material the water duty is low, and after blasting the cemented gravel, an economical method of handling heavy boulders would be required. The mine should be credited with stacking this heavy material in the mine pit if a charge per cubic yard is made for impounding debris.

---

*Nary Red means no red, the gravel being characterized by white quartz which is now shipped to brickworks and sometimes to smelters as a pure silica flux, about 98% SiO_2.

SOUTHERN CROSS AND FRANKLIN.

The Southern Cross Mine exhibits heavy glacial gravel in one pit where worked to bedrock. Elsewhere on this mine and in the Franklin, the old miners washed the lighter top gravel and left the heavy cemented bottom gravel. There is some of this lighter gravel available here, and in adjoining ground.

DUTCH FLAT.

After this Liberty Hill channel runs past the town of Dutch Flat, it joins the main Blue Lead, a little south of the town. The Blue Lead or big channel comes from Gold Run, crosses the railway and swings to the west past the town, crosses the Bear River, passing on to Little York. From here it crosses Steep Hollow, passes on to You Bet, and Red Dog, then crosses the Greenhorn and continues through Hunts Hill and Quaker Hill. All these gravels eventually find their way down Bear River if hydraulicked.

Most of the top gravel has been washed off at Dutch Flat; Lindgren (writing in 1911) says, 90,000,000 cubic yards of it and Turner (in 1891) in Doc. 267 says 105,000,000 cubic yards.

The area of gravel exposed is large. To estimate the yardage remaining, the central portion or main run of the channel was calculated and found to have an area of approximately 647,100 square yards, omitting some rim ground, and the area that the town occupies.

According to the positions of bedrock exposed by shafts and drifts, the depth of gravel on this area varies from 130 feet in the Southern Cross Pit to 200 feet on the main run of the Blue Lead, and is supposed to be 250 feet or more at the railroad. From this I calculate that 34,573,000 cubic yards of gravel remain. Information concerning the position of bedrock is meagre however, and some factor of safety is desirable. There is no evidence of faulting on the Blue Lead and the worst that could happen would be for the shape of channel to change from the flat contour that it exhibits near Bear River and at Gold Run, and assume a steeply sloping V shape. This is unlikely, but the effect would be to halve the quantity and give only 17,286,000 cubic yards. I therefore conclude that there is from 17,000,000 to 34,000,000 cubic yards of gravel on this ground.

These figures show that there is a problem worthy of attack, viz:—the beneficiation of this large volume of gravel.

Information concerning its gold contents between Dutch Flat and the railroad is meagre, but Lindgren (p. 144) says all this ground was drifted. Whether it can be worked at a profit cannot be told without further information. There is, however, a large amount of top gravel that would be easy to wash. In the table of available gravel, 17,286,000 to 34,573,000 of bottom gravel at Dutch Flat is included tentatively.

CHRISTMAS HILL AND LITTLE YORK.

Christmas Hill is a continuation of the Little York gravel. It is also known as the Baltimore Placer. The gravel is small and easily washed giving a duty of 4 to 5 cubic yards per miner's inch. It is reputed to yield 9 to 10 cents per cubic yard giving $200 per day regularly when working with 500 miner's inches. An entry in the old accounts* showed that two months work in March and May 1877 produced $7,984.86 when using 500 M. I. from Bear River ditch. The yardage moved would be approximately:

$$500 \times 4\tfrac{1}{2} \times 2 \text{ months} \times 26 \text{ days per month} = 11{,}700 \text{ cubic yards.}$$

The yield is therefore equivalent to about 6.8 cents per cubic yard.

The gravel remaining on the top bank contains 440,000 cubic yards by survey, and there is a lower bank not surveyed.

In the 1881 Report (Ex. Doc. 98, p. 108) the gravel for these areas was given as 1,089,000 cubic yards.

In the 1891 Report (Ex. Doc. 267, p. 85) Little York is credited with 1,600,000 and Christmas Hill with 1,500,000, a total of 3,100,000 cubic yards. The owner claims a much larger amount than this on Little York alone. There is the gravel occupied by the ruins of the old town, and this bank continues down the side of the channel. The bottom gravel is cemented, particularly the lower 20 feet. The top grovel is said to carry 8 to 10 cents and the cemented bottom gravel 20 cents.

LITTLE YORK.

This company's patent of 1872 included the Liberty Hill, Christmas Hill and Little York mines.

The following bullion figures were taken by me from bullion certificates and accounts of the old Little York Water and Mining Company, in the possession of Mr. W. Maguire of Nevada City.

April 21, 1873, to April, 1874, and then to Sept., 1874, certificates, totalled	$96,228.81
Sept., 1874, to Dec., 1875—certificates totalled	71,191.78
Total from April, 1873, to Dec., 1875	$167,420.59

The new company transferred its office to San Francisco, 330 Pine Street, and all records there were burned in the fire of 1906.

Water Rights.

1400 M. I. for 6 months, there being about 26 piping days in the month. The yardage treated for the season with a duty of 2 yards per M. I. D. would be:

$$1400 \times 2 \times 6 \times 26 = 435{,}800.$$

The 29 months during which the above bullion was obtained would enable the following yardage to be washed:

$$\frac{29}{12} \times 436{,}800 = 1{,}055{,}600 \text{ cubic yards}$$

---

*Accounts of the Little York Company which owned this ground and the Liberty Hill as well.

A yield of $167,420.59 would be at the rate of 15.8 cents per cubic yard, with a duty of 2 yards per miner's inch. The bottom gravel is strongly cemented, but the middle and top gravel is easy to wash.

Rate of Work and Yield Expected.

Using 75,000 M. I. D. from the Bear River Ditch or Maguire Ditch and averaging the duty between the upper and lower gravel at 2 cubic yards per M. I. D. there would be 150,000 cubic yards moved. At 15 cents this would yield $22,500 for the season.

You Bet District.

Between Steep Hollow and Greenhorn, both tributaries of Bear River, the channel has been worked by mines famous in the early days of hydraulic mining, Brown's Hill, Niece & West, Walloupa, Nevada Hydraulic, You Bet, Red Dog, Husseys and Chalk Bluff. These are now consolidated under one ownership. Some excellent gravel remains, and work has proceeded at various times since the injunctions took effect. If the debris were taken care of by a dam, this property would pay to work.

Mr. William M. Strong, mining engineer of Denver, Colorado, examined the gravels in June 1915 and reported 20,000,000 cubic yards of gravel that will yield 10 to 15 cents per cubic yard. About 7,500,000 cubic yards would be discharged into the Greenhorn and the other 12,500,000 into Steep Hollow. Mr. Strong's estimate of the value of the gravel is based upon his own sampling and upon past returns from the mines. If the opinions of miners that have worked in this district may be expressed, this estimate of 10 to 15 cents is below what is expected by them. When hydraulic work was in full swing, there was difficulty in securing grade for sluiceboxes, because the beds of these two rivers filled with debris until the outfall of the boxes were chocked. Both rivers from which water is obtained are short, their drainage areas being: Greenhorn 7⅕ square miles and Steep Hollow 17½ square miles.

The small sizes of these areas are partly compensated for by good rainfall in the higher part of the basin. Additional water might be brought from the South Yuba by a ditch that formerly brought water down the Chalk Bluff Ridge.

Concerning the Red Dog section of this property Mr. Strong reported that under the conditions of 1915 (necessitating impounding by their own dam) there was 3,000,000 cubic yards available. 26 rocker samples of this averaged 25.8 cents per cubic yard, and the cost of working he estimated at 10 to 15 cents.

Mr. F. A. Goodale was in charge of the You Bet property from 1915 to 1920. He says that of the 2½ miles of channel there is still ¾ mile that is untouched, neither hydraulicked nor drifted. In the last operations at Brown's Hill, about 45,000 cubic yards was washed and produced $10,000, a little over 20 cents per cubic yard. At the Red Dog 60,000 cubic yards produced less than $10,000, but panning tests indicate 25 cent value. He considers 15 cents a safe estimate here. The Nevada Tunnel mine stopped in 1918 for lack of grade, 30 feet being required to give elevation in the sluices. This he estimates as 20 cent gravel, and 15 cents may safely be calculated on. Summing up he says that there is from 12,000,000 to 24,000,000 cubic yards of 15 to 17 cent gravel that can be washed if a debris dam is provided.

Mr. H. B. Adsit reported in 1909 that this gravel would average 25 cents per cubic yard for a width of 500 feet and a depth of 25 feet all along the channel. This value was determined from panning tests and previous records.

Rate of Work Possible.

Water is brought in by three ditches, the English Ditch from Steep Hollow, capacity 1400 M. I.; the Irish Ditch from North Fork of Steep Hollow, capacity 1400 M. I.; and the Stehr Ditch from Little Greenhorn, capacity 1000 M. I. This is a total capacity of 3800 miner's inches and would give a large output if the ditches could be kept full.

The catchment areas of these streams is small and the water season would not last long after the rains stopped. A season of at least 100 days should be obtained, as the rainfall in this district is over 45 inches. This would give 380,000 M. I. D. for the rainy season, after which some work could proceed on a smaller scale difficult to estimate. One of these mines, the Nevada Hydraulic used 420,500 M. I. D. in 1880. 380,000 at a duty of 1½ gives a yardage of 570,000 and at 15 cents this yields $85,550. If grade can be maintained in the sluices, particularly at the Nevada Mine, these figures will be exceeded without difficulty.

Hunt's Hill, Quaker Hill, and Buckeye Hill.

When the channel crosses Greenhorn River it continues northward to Scott's Flat on Deer Creek. Mines were worked between these rivers at Hunt's Hill (formerly called Gouge Eye) and northeast of this, at Quaker Hill. From Hunt's Hill the gravel also passes north under the lava and tuffs that cap the ridge emerging at Scott's Flat. This is on Deer Creek, a tributary of the South Yuba.

Opposite Hunt's Hill, on the other bank of the Greenhorn is Buckeye Hill which is only bench gravel and almost all of it removed.* Hunt's Hill and Quaker Hill both discharge into the Greenhorn, thence into Bear River. Quaker Hill gravels are described by Lindgren as being nearly 600 feet deep in the centre of the channel; 35,000,000 cubic yards worked off and 140,000,000 remaining. Turner in Ex. Doc. 267 says 35,000,000 worked, and from 50,000,000 to 90,000,000 remaining, but (p. 92) "unavailable for the greater part by lack of grade for the sluices." This difficulty prevents the richer deep gravels from being worked without elevators, but a shaft was sunk and some drifting done. The banks of the hydraulic pit have been worked in under the tuffs and andesitic material that covers the gravels. Considering all these things, the enormous amount of gravel recorded at Quaker Hill must be regarded as unavailable for hydraulic working under present conditions. Mr. Geo. C. Sargent who had the records of Quaker Hill, lost them in the San Francisco fire of 1906. W. H. Pettee estimated the upper gravels here as carrying 6.6 cents per cubic yard.*

---

*See Lindgren, p. 144, and Turner, in Ex. Doc. 267, p. 92.

HUNT'S HILL.

Hunt's Hill gravel is continuous with that of Quaker Hill but a ridge of tuffs and andesite separates the mining pits.

Hunt's Hill workings are close to the river and bedrock is high enough to enable work to proceed without elevators. The bottom 40 or 50 feet of gravel is cemented, some of it strongly, and stamp mills were the rule for treating it.**

Turner (Ex. Doc. 267, p. 85) estimated that 6,750,000 cubic yards had been removed and 4,000,000 to 5,000,000 was still available. Most of this is cemented bottom gravel similar to that at You Bet and Red Dog, but there is also some light top gravel.

The water used at Hunt's Hill and Quaker Hill came from two ditches, the Union Ditch and Jacob and Sargents. The latter came from Greenhorn Creek, Whitney, p. 424 says Greenhorn Creek supplies 800 miner's inches per day for 9 months to the Quaker Hill Mine.

Mr. W. Maguire estimates that the two ditches supplied 1000 to 1200 miner's inches for a season of 150 days. Jacobs and Sargeant used 54,000 M. I. D. in 1880, according to Ex. Doc. No. 76. This small quantity of water with a duty of 2 would give 108,000 cubic yards for the season. At 15 cents per cubic yard this would yield $16,200.

Summary of Bear River Grounds.

This district is hampered by lack of water and sometimes lack of grade for sluice boxes preventing work upon most promising gravels. The table therefore shows a large aggregate amount of gravel but a very small annual production from it.

Additional Water Supply.

The Cascade Ditch of the Nevada Irrigation District brings water to the old town of Quaker Hill at an elevation of about 3300 feet. The supply of water from this ditch affords hope of working more gravel at Hunt's Hill and at You Bet or Red Dog.

---

*See Whitney, p. 425.

**Mr. Thos. Brady at You Bet recalls stamp mills being used at the following claims: Mallory Bros., Hayward; Couzzen Bros., at Nevada Mine; Judge Barker, Old Red Dog, Bunker Hill (Brady's Mine), Turners (at Hunt's Hill), Carny and Goodspeed (where Chinese worked later at Hunter Hill), Sargent & Jacobs (at Quaker Hill).

SOUTH AND MIDDLE FORKS OF THE YUBA RIVER

SOUTH AND MIDDLE YUBA.

Estimates of Gravels on South Yuba and Middle Yuba Rivers—Quantities in Millions of Cubic Yards.

Name of report	Whitney	Mendell	Board of Engineers	U. S. G. S.	This report
Engineer	(Pettee)	(Larson) Ex. Doc. No. 98	(Turner) Ex. Doc. No. 267	Lindgren Prof. Paper 73	(Jarman)
Year	1879	1881	1891	1911	1926
South Yuba:					
North Bloomfield	700	No estimate	65	130	Over 50
Lake City			110	Probably 130	
Last Chance, Porter and Brockmeyer			40		
Relief Hill			15	No estimate	15
Washington			3		Over 3
Blue Tent and Sailor Flat		4.84	30 to 60	90	2
Grizzly Hill		1			
French Corral		1			
Omega			20	40	24
Alpha				1	
Totals for South Yuba			283 to 313	400	Over 94
Middle Yuba:					
San Juan and part of American Mine			2.5		
Badger Hill and Cherokee			33		Over 442
Patterson			96		
Wolsey Flat			1.5		
Moore's Flat, Orleans Flat and Snow Point			14.2		Doubtful
Totals for Middle Yuba			147.2		Over 442

Rate of Work Expected on South Yuba and Middle Yuba Rivers and Production for First 20 Years.

Mine	M.I.D. available	Duty	Per annum		For twenty years	
			Yardage	Yield	Yardage	Yield
South Yuba:						
Bloomfield Hydraulic and Lake City	650,000	4	2,600,000	$260,000	52,000,000	$5,200,000
Blue Tent	15,000	2	30,000	4,500	600,000	90,000
Relief Hill	120,000	3½	420,000	37,800	8,400,000	756,000
Washington	145,600	1	145,600	47,320	2,912,000	946,400
Omega	358,000	3	1,074,000	139,620	21,480,000	2,792,400
French Corral, etc.			Not benefit	ed by a dam	at Jones Bar	
Totals	1,288,600		4,269,600	$489,240	85,392,000	$9,784,800
Middle Yuba:						
Badger Hill or North Columbia District. Moore's Flat District	650,000	4	2,600,000	$260,000	52,000,000	$5,200,000
Totals for Middle and South Yubas combined	1 938,600		6,869,600	$749,240	137,392,000	$14,984,800

SOUTH AND MIDDLE FORKS OF YUBA RIVER.

Between these two rivers lies the largest body of gold bearing gravel capable of being worked by hydraulic methods. It extends from Badger Hill to North Bloomfield, a distance of 9 miles. At the western end near Badger Hill the top soil and gravel was washed away from an area approximately four miles long and ½ to 1¼ miles wide. This area extends from Badger Hill and Paterson to where Spring Creek crosses the deposit about a mile to the east of North Columbia or Columbia Hill.*

From Spring Creek the gravel continues eastward covered by trees and undergrowth for about a mile when we find the hydraulic workings of the Union Mine. To the east of this the gravel continues untouched through Lake City where it passes under an andesitic cover forming a ridge 400 feet high. About 3 miles from Spring Creek we reach the western bank of the hydraulic pit of the Bloomfield Hydraulic Mine (also known as the Malakoff Mine). In traversing this pit and the gravel at the far east end we travel another 2 miles before the gravel disappears under a cover of andesitic tuffs, lavas and breccia.

This brief description covers a gravel channel 9 miles long and ½ to 1¼ miles wide, which contains over 800,000,000 cubic yards of gravel, computed from reliable survey data.

This enormous body of gravel was formed by several big rivers that joined each other in the course of the 9 miles. One came from the east and flowed west through Snow Point, Orleans, Moore's Flat and Derbec to North Bloomfield and so on down the big channel already described. Another flowed west through Omega and Alpha, then Relief Hill and on to Bloomfield and Malakoff and down the main channel described. A much larger river flowed north; it started from Michigan Bluff, passed through Forest Hill, Yankee Jim to Iowa Hill across to Indiana Hill and through Gold Run to Dutch Flat. Here it was joined by the Liberty Hill stream coming west, then on to Little York, You Bet and Red Dog, Hunt's Hill and Quaker Hill to Scotts Flat. From here it continued north but is covered by andesite and is found again at Sailor Flat and Blue Tent after which it crosses the course of the present South Yuba River to Grizzley Hill and joined the big channel at Spring Creek. Having combined their forces these rivers travelled as one big stream through the Columbia Hill area. Top gravel has been removed by mining from here down to Badger Hill. Further west the gravel was found and mined at North San Juan, Sebastopol, Sweetland, Birchville and French Corral, and again lower down the river at Smartsville. Most of the gravel at and below North San Juan has been worked but there are some banks that may be profitable if dams could be arranged and particularly at Smartsville and vicinity, where there is a large quantity of gravel which paid well in former times. The latter, however, lies below the dam site at the

---

*These two names are interchangeable; the post office is called North Columbia but the town is known as Columbia Hill, which leads to confusion until the visitor becomes conversant with the names, especially as old maps show Columbia Hill as a settlement 4 miles east of this.

Narrows, and at this place the Yuba leaves the Rocky gorge and widens into a broad stream that is difficult to dam.

The origin or formation of these gravels was interpreted in this way by early miners, the channels of each district being studied carefully as their drift mine workings show. River action, glacial action and sea beach action each had their advocates. We now know that glacial action was chiefly responsible for carving these valleys in slate and other bed rocks, often leaving remarkable evidence of ice action. Glacial gravel and morainal material frequently occupies the bottom of the trough; above this is found heavy river gravel and finer gravels, with sandy layers at times. Still higher are finer gravels, sands, tuffs and sometimes clays.

Geologists and others accustomed to record their observations in permanent form were attracted to these famous gold fields and we have Prof. T. D. Whitney's records of the examinations and data collected by Mr. W. A. Goodyear in 1871 and by Prof. W. H. Pettee in 1879, also those of engineers of the California State Mining Bureau, notably Henry DeGroot in "Notes on Hydraulic Mining," Report for 1880; Russell L. Dunn in "Drift Mining in California," Report for 1888, VIII; John Hays Hammond in "The Auriferous Gravels of California" in the Report for 1889, IX.

Still later, the U. S. Geological Survey assigned to Mr. Waldmar Lindgren the duty of studying this area and as a result we have his professional paper No. 73 published in 1911.

Whitney's Volume and Lindgren's Bulletin are both out of print and copies should be guarded with care by those lucky enough to possess them.

Geological features are of interest in enabling the reader to understand influences drawn from data gathered at the mines. All gravels vary in their gold contents on or near the bedrock of the stream, but the main bank of this enormous body of gravel is not likely to vary much in its gold content by reason of the averaging of conditions that occur in the deposition of so large a mass of material.

Mr. W. W. Waggoner of Nevada City, consultant to many gravel mines, has recorded and correlated all the known survey data relating to this area and submitted detailed maps which he made. He mapped the elevations of bedrock exposed by the action of water-courses and by mining drifts, shafts, drill holes, and by actual hydraulic work. In this way he produced a **contour map of the bedrock.** Having the contour of the gravel surface and also of the bedrock that lies below it, the quantity of gravel may be calculated with only a small percentage error. Such data also shows the shape of the deposit and makes it possible to determine the best method of attack.

Consideration of Different Methods of Working This Gravel.

It does not appear to be possible to work this gravel profitably by any method other than that of hydraulicking. The good values that lie in the lower gravel and on bedrock cannot be recovered by dredging as the depth of the deposit is too great—150 to 300 feet.

The largest dredges in the world are those of the Natomas Company of California operating near Natoma, and those of the Yuba

Consolidated Goldfields at Hammonton on the Yuba, below the Narrows. The Natoma dredges have buckets of 15 cubic feet capacity and dig 150,000 to 225,000 cubic yards per month and operate at an average cost of 6½ cents per cubic yard;* those of the Yuba Consolidated are of similar size and operate at a lower cost owing to exceptionally favorable conditions. These enormous dredges do not dig deeper than 86 feet, and values in this 86 feet probably will not exceed 6 cents per cubic yard. The gold is chiefly in the bottom layers and the gravel is 150 feet or more in depth; therefore, dredging would not pay, as the richer bottom gravel would be untouched. A plan to dissolve the gold from the gravel as it lies in place using cyanide as a solvent might be feasible but would be subject to percolation difficulties caused by thin layers of very fine sand or clay.

On the other hand hydraulic mining is a positive method that enables all gold to be cleaned from the bedrock and the crevices in it, and the operating costs are the lowest of any method of handling gravel and extracting its gold contents.

The costs at Bloomfield averaged 4.53 cents per cubic yard for the nine year's work. Wages are higher than they were at that time and supplies are more costly, also water; but making due allowance for these things the cost for the actual mining of such gravel should not exceed 7 cents according to engineers of the River Mines Company. The figure will depend upon the methods adopted to obtain a large output with the minimum of labor.

Mr. Waggoner calculates from his survey data that the area described contains 886,600,000 cubic yards of gravel. Another engineer using the same data but calculating by his own method reported 891,000,000 cubic yards. In 1876, while mining was active on this area, Mr. J. D. Hague, mining engineer of New York, estimated that 4400 yards length along the channel would contain nearly 300,000,000 cubic yards of gravel. The gold contents he estimated at from 6 to 12 cents per cubic yard, but this value was not determined by sampling; it was deduced from returns obtained from mines working along this ridge, which was famous as the "San Juan Ridge."

The larger area that we are considering he estimated contained 700,000,000 cubic yards. In making this estimate Hague was obliged to assume the contour of bedrock in places where data had not been obtained. Subsequent estimates made from fuller data show that his assumptions were justified.

Quantity of "Workable" Gravel.

Mr. Waggoner's figure of 886,600,000 cubic yards represents the total gravel situated so that it would be possible to mine it, without consideration of ownership. Tunnels would be needed from the river banks to enable the gravel to be washed down sluices with sufficient "grade" or fall to give the water good transporting power. Small rim gravels in remote positions were left out of account in the above estimates.

---

*See Report XXI of California State Mineralogist, Jan., 1925, pp. 13 and 14.

Values Contained.

We next have to consider whether sufficient gold is present in this gravel to enable operations to pay. Obviously any gravel that is of too low grade to show a profit must be deducted, and similarly, gravel that shows too large a percentage of clay should be left out of account since clay is difficult to work and causes losses of gold from sluice boxes. Thick bands of clay or barren volcanic "tuffs" or of sand require high values in the remainder of the gravel to give an average for the whole bank that will be profitable. On this account the eastern bank of the Malakoff or North Bloomfield Mine would not be worked under the proposals now made, as the average values are too low to pay under the new conditions. There are two layers of clay each over 20 feet thick and there is also considerable sandy material. This eliminates from consideration all the gravel at the eastern end of the pit estimated at 86,700,000 cubic yards and leaves 799,900,000 to be considered. There is clay and sand at the western end of this area at Badger Hill, but prospecting operations indicate that gold in the gravel is sufficient to sweeten the average up to 10 cents. The general average from the western bank of the Bloomfield Hydraulic or Malakoff Pit to the far western end at Badger Hill is expected to yield from 9 to 12 cents per cubic yard along the middle of the channel.

Rate of Work Possible.

At this point it is well to call attention to the fact that this enormous bulk of material that can only be worked at a moderate rate. So that although 800,000,000 cubic yards is available it will not be possible to work more than one-eighth of it in the first 20 years under the plan now proposed.

The water available for work by the River Mines Company that owns most of the ground is about 1,300,000 miner's inch days per season. To this must be added "way water" or water picked up on the way down the ridge. Further supplies could be developed from the Middle Yuba but would require considerable capital. This might be done after the available supplies are fully utilized, which would take several years to accomplish, but for the first 20 years I have taken an average of 1,300,000 M. I. D. as the available water supply. With the best methods and with grades of 4½ per cent in the sluice boxes, a duty of 5 may be maintained on this gravel, but as a matter of caution, 4 has been used for these estimates, i.e. 4 cubic yards of gravel washed per miner's inch day of water.

This gives 1,300,000 x 4=5,200,000 cubic yards as the bulk of material that could be washed per season. At this rate 800,000,000 cubic yards would take over 150 years to exhaust. Therefore, it is no use to talk volubly of the enormous amount available, or of the $72,000,000 to $96,000,000 in gold that it is expected to produce. For the present it is sufficient to make plans for mining a portion of this area with the facilities that are within reach, calculating for 20 years immediately succeeding the erection of a dam at the Narrows, on the Main Yuba. The plan first considered required 3 dams, one on the Middle Yuba near Freeman's Bridge, another on the South Yuba near Norton's Canon and a third at Shady Creek, (Jones Bar), after that at Norton's Canon has been almost filled. The preliminary estimates of costs given in Table II, page 16, showed that this plan was far too costly.

In 20 years it would be possible to mine 104,000,000 cubic yards and produce from $9,360,000 to $12,480,000. It would take several years to attain this rate of work. The ditches and flumes at the headwaters carry about 5500 miner's inches and would have to be enlarged to carry the full amount of water available.* Thus, there would be a period of several years during which work would be on a smaller scale, increasing as more water became available and as the hydraulic mine pits were developed to utilize it. New tunnels and sluices would be required to carry the gravel, and hydraulic pits would have to be opened at the heads of these tunnels. The gravel mined would increase until it exceeded 5,200,000 cubic yards per season. The total for 20 years would probably be 104,000,000 and the gold output $10,400,000.

Gravel Available and Values in the West Bank of Bloomfield Hydraulic Mine.

At the east end of the ground described we have the mine known as the Malakoff, North Bloomfield or Bloomfield Hydraulic. The latter is the correct name. It has already been explained that it would not pay to work the eastern end of this pit under the new conditions because of clay and tuff in the bank of gravel which reduced the value per cubic yard. After 1878 all mining proceeded eastward as the bedrock rises going east, and the western bank ran out of grade. The western bank was washed through what was known as No. 8 shaft on the line of the Humbug Tunnel and the mine is called No. 8 in the reports of Hamilton Smith, Jr., General Manager for the North Bloomfield Company. This tunnel was completed in 1874 and a raise put up to surface. The gravel was washed through this, mostly surface and middle gravel for the first year, next year a little bottom gravel as well, and the third year 1876-77, bedrock was well exposed and the mine was worked both to the east and west. The effect of the richer bottom gravel is shown by the higher returns. Next year there was no work westwards as they had run out of grade. In 1877 the bottom 65 feet of gravel was washed separately from the top 200 feet, and yardage was computed from surveys with the following results:**

Top gravel 1,591,730 cubic yards yielding 3.8 cents per cu. yd.
Bottom gravel 702,200 cubic yards yielding 32.9 cents per cu. yd.

The annual reports of W. Hamilton Smith, General Manager of the North Bloomfield Company, are the best statistics of the work of any company that operated on a river leading to the Grand Valley of California. From them and from other data Mr. Waggoner prepared the following table which shows that in nine years 26,619,571 cubic yards yielded $2,611,800.17 or a rate of 9.81 cents per cubic yard.

---

*In 1876 Mr. J. D. Hague reported that 1,500,000 M.I.D. were actually delivered to mines by the ditches on this ridge.

***See* Hydraulic Mining by Bowie, p. 74.

Statement of Yield from North Bloomfield Mine.

Year	M.I.D. water used	Duty, cubic yards per M.I.D.	Yardage	Yield	
				Value	Per cubic yard
1875	465,822	*4.8	2,235,946	$ 83,078 63	$0.0272
1876	786,200	*4.17	3,278,454	200,366 54	0611
1877	597,000	*3.86	2,304,420	291,125 42	.126
1878	796,499	*3.7	2,947,046	311,276 70	.106
1879	919,008	†3.6	3,308,429	331,759 76	.10
1880	945,550	†3.6	3,403,980	287,924 18	085
1881	744,600	†3.6	2,680,560	236,935 14	.088
1882	988,250	†3.6	3,557,700	386,146 23	.108
1883-1884	806,399	†3.6	2,903,036	483,187 57	.166
Totals	7,049,328	3.77	26,619,571	$2,611,800 17	$0.0981

*Determined by survey.
†Assumed approximately same as previous work.
In 1881 mine suspended for 4 months by injunction.
Last line, 1883 to 1884, is to February 1, 1884, when closed by permanent injunction.
During 1870-1874, 3,250,000 cubic yards of top and side gravel were washed from various places yielding $96,700, making the total yield $2,829,869.59 or 9.1 cents per cubic yard.

Photo by Arthur Jarman.

MALAKOFF, OR BLOOMFIELD HYDRAULIC MINE.

Debris from this mine will be restrained by a dam at the Narrows on the main Yuba. This mine yielded at the rate of 9.8 cents per cubic yard for nine years before injunctions were issued, see table printed above.

The low returns of the first two years were due to the large proportion of top gravel washed in the process of opening the pit. The higher return of the third year shows the effect of including bottom gravel when working on bedrock both east and west. The continuation of this gravel westward is assured and the estimates of quantity are based on survey data recorded by Mr. Waggoner.

In assigning a value to this material I have assumed a continuance of the value 9.8 cents because there has been no testing by prospect shafts to the west of this bank. If there had been, it is a question whether the results would more truly represent the value of the next fifty millions of cubic yards that it is intended to work in twenty years than the yield from washing 26,600,00 cubic yards. As a matter of precaution new ground should be tested by washing gravel excavated from test pits or sampling shafts. In this case no sampling has been done and the gravel is calculated at 10 cents in estimating the output on the South Yuba. Much rim gravel was washed in former work, but even so the values obtained averaged 9.1 cents per cubic yard. In future, selective mining will be used, operations being confined to the center of the channel, thus leaving low grade rim gravels untouched. Working in this way the engineers of the River Mines Company expect yields of 10 cents per cubic yard.

The contour of the bedrock shown by Mr. Waggoner in his map of this ground shows a slight increase in grade going west to Lake City. This, together with the junction of a channel coming in from the north, would favor increase in values as the work on this bank proceeds westwards.

Before opening the Bloomfield Mine, four prospect shafts were sunk to determine the position of the channel, and 1200 feet of drifting was done to test the value of the ground. No shafts have been sunk to prove the ground that it is proposed to work to the west, but the run of the channel is known because of drift tunnels and washing that has uncovered the bedrock at several places between here and Lake City. Towards the north, a covering of andesite masks the surface of the gravel, but it has been eroded through at sufficient places to allow an estimate of the probable gravel available. The gravel behind the face of this hydraulic pit is deep and there is over 50,000,000 cubic yards in a section of ground examined by me, less than 150 acres in area. From this bank to Lake City if the channel maintains the same shape as it has every indiction of doing, the quantity of gravel would be over 150,000,000 cubic yards.

Mr. Waggoner has computed it as 172,000,000 to 195,000,000. From the main pit of the Bloomfield Hydraulic the amount excavated was 29,000,000 as given in Ex. Doc. 267, p. 84, but since that time another 11,000,000 was worked and the debris was stored in the pit itself, the water flowing over a debris dam and down the tunnel to Humbug Creek. The pit therefore represents an excavation of 40,000,000 cubic yards, less 11,000,000 stored in it and the 50,000,000 cubic yards of new gravel mentioned above would constitute a mine greater than that already excavated.

The Malakoff shaft was sunk to bedrock in 1922 and for a depth of 110 feet it showed 71 cents per cubic yard. This is close to the bank of gravel which is to be worked. No. 1 shaft was sunk 207 feet and the bottom 135 feet showed 41 cents per cubic yard.

Method of Attack.

To work this block of gravel it would be necessary to drive a new tunnel 4800 feet long in a northerly direction from the mouth of Humbug tunnel. This would give 4½ per cent grade to the bottom of the channel. A shorter branch tunnel might be driven from the present tunnel, but this would not serve for long. In any case tunnelling is necessary to enable systematic mining to continue, and it would be done while the dam is being built.

Humbug Creek discharges into the South Yuba about 1½ miles above the damsite called Norton's Canon, and about 15 miles above the damsite at Shady Creek or Jones Bar. Because of the large amount of storage needed for this Lake City-Bloomfield gravel the plan first contemplated required a dam at Norton's Canon built to a height of 290 feet, giving 68,000,000 cubic yards of storage and before 20 years elapsed a second dam wauld have been needed at the lower site at Jones Bar. Preliminary estimates from surveys in 1926 have shown that storage can be obtained more reasonably at the Narrows on the Main Yuba River, see Table II, page 16.

A study of the contour map shows that it would be feasible to attack other portions of this gravel from the South Yuba side if subsequent developments warrant doing so, but the western end at Badger Hill would be attacked from the Middle Yuba side.

Yield Expected.

Using half the water available on this ridge, 650,000 M. I. D., a duty of 4 would give 2,600,000 cubic yards for the average season's work. This at 10 cents,would produce $260,000.

Other Mines in the Bloomfield Lake City Area.

In addition to the Bloomfield there were several other diggings or mines that produced gold from this vicinity all sending their debris to the South Yuba; the Brockmeyer, Paine diggings, Sherwood diggings, Dutch Boys diggings. It is improbable that there will be enough water to enable these diggings to be worked as separate concerns until the industry has had time to establish itself.

Just west of Lake City, and about 2 miles west of the Bloomfield Hydraulic Mine is the Union Hydraulic Pit. This discharged debris into Spring Creek, which empties into the South Yuba about five miles below Humbug Creek. Further west there begins a continuous series of mine pits that extend from North Columbia to Badger Hill. The first of these was known as the Consolidated Mine, as it was a consolidation of many small claims. This and the Union Hydraulic both drained into Spring Creek and in all probability future working would be done by sending the debris into the South Yuba.

Other Mines That Discharge Into the South Yuba.

SAILOR FLAT AND BLUE TENT.

An enormous quantity has been worked here, estimated at 15,000,000 cubic yards (see Doc. 267, pp. 84 and 89) and a very large amount remains, given as 30,000,000 to 60,000,000 cubic yards but there are many reasons which combine to make it improbable that any of this will be touched except a small amount of bottom gravel on the Blue Tent ground. The bedrock dips away from the river making it difficult to follow up with rockcuts and drainage tunnels and the main banks are remarkable in showing a large proportion of tuffs, fine sand and grit which would not be expected to be gold bearing. This material washed easily giving a duty said to be 10 cubic yards to the miner's inch of water. The proportion of true hydraulic gravel below this is probably small. It is not visible, being covered by slides of material from above. Work had already been carried up to the cover of andesite and this would further reduce the value of the returns.

Larson's estimate for the gravel workable at Sailor Flat is 4,840,000 cubic yards* it being limited to this amount because of the large amount of barren material in the banks.

At the Blue Tent (Gopher Hill Pit) there is some bottom gravel partly occupied by the ruins of the old town and this looks to be good hydraulic gravel. This bank varies up to 160 feet high and contains over 2,000,000 cubic yards. Behind this, at the Enterprise Mine a considerable amount of work was done on material similar to that at Sailor Flat.

W. H. Pettee in Whitney (p. 414) says that 632,533 cubic yards washed in 1876-77 yielded 12.6 cents per cubic yard at Gopher Hill. In 1878, 501,028 cubic yards yielded 14 cents to the cubic yard at Gopher Hill. In the same year at the "Blue Lead" (same company's ground) 235,703 cubic yards yielded 7 cents per cubic yard. At the Enterprise pit of the same company 1,398,963 cubic yards of fine loose sandy material was washed in 1876-77 for a yield of 2.06 cents per cubic yard, barely enough to cover expenses.

RELIEF HILL.

About three miles east of North Bloomfield, on the North Bank of the South Yuba, is Relief Hill where 6,000,000 cubic yards is estimated as having been washed and from 5,000,000 to 15,000,000 available. Owners of ground here estimate there is 30,000,000 cubic yards available to the southwest and west of the old workings. A duty of 3 to 4 was easily obtained as there was plenty of grade. There are two ditches that give a short local water season of 1200 miner's inches. Some extra water can be purchased from the Bloomfield Company's ditch. Ex. Doc. No. 267, p. 88, says that the Eureka Lake Company's holdings here did not pay. The other ground was worked for many years by a group of miners with success, though the returns are not known. After being enjoined they continued to work illegally from time to time.

After injunctions considerable drifting was done. Exact returns are not known but are reported as \$30,000 to \$40,000 per year (see Lindgren p. 140). The gravel appears to have the general character of that at Omega and at Bloomfield, and should produce 9 to 13 cents per cubic yard where not drifted. The owners expect very much higher results. The bulk of the debris could be retained in the canon and only the fines need be sent down the river.

Rate of Work Possible.

1200 M. I. for 4 months=about 120,000 M. I. D. for the season. With a duty of 3½ this would treat 420,000 cubic yards. At 9 cents per cubic yard this would yield \$37,800.

If results equal to this be obtained, this ground would pay for the development of a water supply to prolong the season.

---

*See Ex. Doc. 98, pp. 108 and 109.

WASHINGTON.

Four miles further up the river there is a flat of unworked secondary gravel on the south side of the river, which is being prospected by the Washington Mining and Development Company. There is about 120 acres covered by gravel 35 feet deep or more. This has been tested by four shafts, which showed from 8 to 18 feet of bouldery gravel at the bottom, and ordinary river gravel above. The latter carried 8 to 12 cents per cubic yard and the bouldery gravel was richer, but very variable.

When drifting, a test on 46 carloads showed that the bottom gravel carried $1.42 per cubic yard before discarding the boulders. 69 carloads from another portion of the property showed $2.28 per cubic yard. A shallow gravel like this can be hydraulicked with good profit, but being alongside the river a dam must be provided on the river itself at some place lower down as at Norton's Canon. The company has water rights on Scotchman's Creek and a ditch that conveys water used for ground sluicing. This can readily be made to carry 800 miner's inches.

Rate of Work and Yield Expected.

800 x 26 x 7=145,600 M. I. D. This gives 145,600 cubic yards for the season. Half of this at 15 cents and half at 50 cents would give $47,320 for the season. The richer gravel on the bedrock and the gold from crevices in the bedrock may augment this figure considerably, but with these secondary gravels it is impossible to forecast what may be obtained owing to their spotty nature.

OMEGA.

This mine is about nine miles in a direct line east of North Bloomfield and is on the south side of the river. From it can be seen Alpha and other points where gravel has been worked, then Relief Hill and behind that, Bloomfield, these places marking the track of the old river that laid down these gravels. Omega is well known as having gravel that gave good profits, it being easy to move and regular in gold contents, averaging 13½ cents for the whole bank. About 13,000,000 cubic yards have been mined and an additional 24,000,000 may be mined before the overburden of andesite will give trouble. If the gravel maintains its previous record for regularity of returns the whole of this will pay under the new conditions. The company possesses its own ditch that brings 5000 miner's inches from the South Yuba, also another ditch bringing 1200 miner's inches from Diamond Creek. The latter has been renewed this year and the former is being repaired. There is about nine miles of timber fluming (6 ft. x 4 ft.) alongside the river at the head of the larger ditch.

5000 M. I. for 6 months of 26 piping days=780,000 M. I. D.
1200 M. I. for 4 months of 26 piping days=124,800 M. I. D.

Total water for season------------------904,800 M. I. D.

In 1880 these ditches supplied a total of 358,000 M. I. D. With a duty of 3 this would treat 1,074,000 cubic yards for the season. At

13 cents this would yield $139,620. These are the figures used in Table on p. 71.

This rate of work would soon be attained if the ditches are cleaned out after the timber fluming has been repaired. About 3 miles of this fluming was repaired this summer ready to hydraulic. The figures indicate that the rate of work done in 1880 may be exceeded.

Mines That Would Discharge Into the Middle Yuba.

At the west end of the area described on p. 72, there were several mines that discharged into Shady Creek and its tributaries. This creek joins the South Yuba about 10 miles below Spring Creek. It has not sufficient fall to clear itself from the large amount of debris discharged into it and this very materially delayed work in the mines above.

A tunnel 12,000 feet long could be driven to tap these gravels from the South Yuba and give good grade, but 7,800 feet of driving would do the same work from Grizzly Creek, a tributary of Middle Yuba. Two shorter tunnels could also be driven from Grizzly Creek to tap the Patterson gravels. Therefore, a dam site was surveyed near Freeman's Bridge on the Middle Yuba for gravels between North Columbia and Paterson's or Badger Hill.

The site for the dam is a good one and gives impounding capacity more reasonably than any other site on the Middle Yuba. An alternative site was examined below Emory Ford or Emory Flat. A dam there would catch this gravel but the rock at the site is heavily jointed. Therefore, it is preferable to go four miles lower down to Freeman's where there is not this disadvantage, and where storage would be developed at less cost.*

The gravel that would be washed from this western end was formerly worked by a number of mines known as the Central, Consolidated, Eureka Lake, Laird, Farrel, Western, McCarty's, Patterson, Badger Hill.

The quantity of gravel remaining is readily calculated from the contours of the gravel surface and the contours of the bedrock in which it lies.

Leaving rim gravel out of account I calculated 442,000,000 cubic yards here that will be readily accessible when tunnels are driven from Grizzley Creek. Mr. Waggoner in a detailed examination estimated that 627,000,000 cubic yards are available. Mr. C. H. Munro indicates that attention would be chiefly directed to the central portion of the channel that he estimates contains 275,000,000 cubic yards.

The gravel already worked from these areas was top gravel, most of it light and not of great value; bedrock has not been reached, except at Badger Hill. Records of production are fragmentary as there has been no obligation imposed on owners to record their returns.

---

* Written before estimates of costs were obtained for dams on these sites and before agreement was reached for storage in the proposed dam at the Narrows on the Main Yuba River.

Table of Yields.

Mines	Cubic yards	Value per cubic yard	Yield	Year	Cost of water per M.I.D.
William Weigel	4,320,800	$0.06 to $0.08	$345,663 10	1865–1868	$0 25
McCartys	3,000,000	.0433	129,904 53		20
Grey's Diggins			(22,288)		
Eureka Lake Company		.041		1875	20
Consolidated	1,110,000	.031	35,776 72	1881	
Farrel	1,922,000	.050	96,115 52	1881	
Laird	1,120,000	.034	38,645 30	1881	
Consolidated	1,970,000	.044	86,800 00	1884	
Laird	346,000	.031	10,700 00	1884	
Totals	13,788,800		$743,605 17		
Average		$0.0535			

The table of yields given is compiled chiefly from data given in Mr. Hague's report. This shows a range of value from 3.1 to 8 cents and an average of 5.35. This was top gravel easily moved like that washed at North Bloomfield, Dutch Flat, You Bet and Gold Run, and similar to those other gravels in being of low value.

One shaft was sunk on the Consolidated ground. This showed a depth of 237 feet of gravel remaining and that it was originally 500 feet deep. Some drifting was done to determine the run of the channel which was found to be 600 feet wide (see Ex. Doc. 267, p. 88). The values from this work are not on record. A few miles further east the work done at North Bloomfield in 1887 showed that 1,591,730 cubic yards of gravel from the top 200 feet on the mine yielded 3.8 cents per cubic yard, and 702,200 cubic yards from the bottom 65 feet yielded 32.9 cents per cubic yard. The average for the 265 feet was 12.7 cents per cubic yard.

With yields of from 3.1 to 8 cents for the top gravel of the Columbia deposit we may reasonably expect something of the order of 9 to 12 cents from the gravel that lies below, at any rate in the central portion of the 627,000,000 cubic yards of gravel that remains. It is well to recall the general average of 9.8 cents obtained from 26,000,000 cubic yards mined at Bloomfield. Before work is commenced on this area it is probable that several trial shafts would be sunk to determine whether one portion of the ground is appreciably different from the rest. The expense of renovating the ditches and refitting the mines and for tunnelling would be considerable and if one portion of the gravel is richer than the rest it would be well to work that ground as early as possible.

Mr. C. H. Munro, Consulting Engineer for the River Mines Company, who has had extensive experience in hydraulic and dredge mining, has made a careful study and valuation of this deposit between North Bloomfield and Badger Hill. He writes as follows under dates of January 7 and January 31, 1927:

> "The total length of channel considered is about 34,000 feet. The extensive drill prospecting work, coupled with mining operations, indicates 18,000 feet of channel, or 275,000,000 cubic yards, with an average recovery value of 10.5c per cubic yard, on the western portion."

"On the eastern, or North Bloomfield end, 5200 feet of channel have been worked to bedrock, with an average recovery of 9.06c for 29,870,000 cubic yards. Previous to the completion of the North Bloomfield bedrock tunnel short tunnels were run at elevations higher than the bottom of the channel to mine off the top gravels. In some places these top gravels were mined to a width of 4800 feet. A large area of low grade ground was taken from the north and south rims in this area, which would otherwise not have been mined if the bedrock tunnel had been completed earlier. In future it will not be necessary to mine to the width as shown in the North Bloomfield pit but by selective mining or confining the operations to the pay channel a better recovery per cubic yard should be obtained than was secured from the former mining operations. It is, therefore, reasonable to assume that the eastern portion of the channel from the east end of the drilled area to the Malakoff pit, a distance of 16,000 feet, should give an average recovery of 10c per cubic yard for a total of 133,000,000 cubic yards."

"Summarizing the above figures, we have available selective yardage as follows:

San Juan Channel	*Length*	*Cubic yards*	*Recovery value, cents*	*Total value*
Western portion	18,000 ft.	275,000,000	10.5	$28,[illegible]
Eastern portion	16,000 ft.	133,000,000	10.0	13.3[illegible]
Totals and averages	34,000 ft.	408,000,000	10.3	$42,175,000

"When you consider the extent of drilling development over the 34,000 feet of channel and also that 5200 feet were mined to bedrock on the eastern end, the con[illegible] arrived at above are fair and reasonable."

"As soon as it is definitely decided that tailing storage space can be secured at a low cost, it is the intention of the River Mines Company to equip their large hydraulic property of San Juan Ridge for active mining operations."

At the above value, hydraulic mining would pay if the impounding is cheap and if the miner is assured that he may continue to mine upon complying with the regulations of the Commission.

With the assurance that there will be an adequate dam on the south and on the Middle Yuba it would pay to drive all the tunnels mentioned and to renovate ditches and flumes and refit the mines on this area. But unless there is the security that such work may be prosecuted regularly for many seasons it would be futile to expend the capital required. To recover this capital and earn interest upon it it will necessitate many years of work.

Rate of Work Possible.

On the Middle Yuba side of the ridge there would be available the other half of the water distributable by ditches belonging to the River Mines Company, viz:—650,000 M. I. D. for the year, plus "way water". The Consolidated, Farrel, and Laird diggings used 903,522 M. I. D. in 1881 according to Hague's report.

Additional water could be obtained from the Middle Yuba by excavating a ditch, but the cost would be large. Many ditch companies organized in the old days spent much money and were unable to return their capital to the shareholders: therefore, water that would entail building an entirely new ditch of considerable length is not included in this estimate. "Way water" will help considerably, however.

The duty obtainable on gravels at this end of the North Columbia deposit would be about the same as that obtained at the eastern end, viz. 4 cubic yards or more per miner's inch. 650,000 x 4 gives 2,600,000 cubic yards for the season. The same yardage would be obtained if some water from these ditches were diverted for work at Moore's Flat, Snow Point, or North San Juan, the only difference being that some of the gravel would be mined at these other places.

The above is a conservative estimate because "way water" or water picked up on the way would be considerable on the long run of ditches from Lake Bowman to the mines.

With a yearly yardage of 2,600,000 it will take a long time to work the gravel known to be available. It is, therefore, probable that means will be found for developing additional water and the above rate of work may be largely exceeded. In the meantime 2,600,000 cubic yards per annum is my estimate of what will be done provided that assistance be given through the erection of a large dam.

Other Districts on the Middle Yuba.

At Moore's Flat, the Blue Bank and Boston Mines worked their way well into the bank until they had to contend with a heavy cover of andesite. This finally came down as a large landslide and stopped hydraulic operations by smothering the rock cuts and boxes. To work behind this slide would necessitate sluicing away sufficient material to uncover the rock cuts and it is a matter of opinion whether this would pay. The Blue Bank was rich, and miners have assured me that it would pay to work, but I have not included it in the table of gravels available.

Water for work at Moore's Flat was drawn from ditches that supply water for the main area at North Columbia, viz, the River Mines Company ditches.

The yields for 1881 from Snow Point and Boston Mines were given by Mr. Hague as follows: Snow Point $27,387.24, giving $6,635.55 profit. At 4.9 yards to the M. I. D. this worked out at 11.3 cents per cubic yard and a cost of 8.5 cents. Boston yielded $140,407.39 giving $81,705.14 profit at 4.9 yards per M. I. D.; this gives 14.5 cents per cubic yard and a cost of 6.9 cents.

Some small areas of gravel are known on the Middle Yuba and its tributaries, and will be workable if a dam is provided at Freeman's for the North Columbia gravels. I did not examine them as they are widely separated.

19816 2-27 1650

STATE OF CALIFORNIA

Fish and Game Commission

TWENTY-NINTH BIENNIAL REPORT

For the Years 1924–1926

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1927

48323

BOARD OF FISH AND GAME COMMISSIONERS.

POSTAL TELEGRAPH BUILDING. SUTTER 6100.

SAN FRANCISCO, CALIFORNIA.

Commissioners appointed by the Governor, by and with the consent of the Senate. Term at pleasure of Governor. No compensation.

I. ZELLERBACH, President	San Francisco
M. J. CONNELL, Commissioner	Los Angeles
RALPH H. CLOCK, Commissioner	Long Beach
B. D. MARX GREENE, Executive Officer and Attorney	San Francisco

DEPARTMENT OF PATROL.

J. S. HUNTER, In Charge	San Francisco

DEPARTMENT OF FISH CULTURE.

W. H. SHEBLEY, In Charge	Sacramento

DEPARTMENT OF COMMERCIAL FISHERIES.

N. B. SCOFIELD, In Charge	San Francisco

BUREAU OF FINANCE AND ACCOUNTS.

H. R. DUNBAR, Assistant Executive Officer and In Charge	Sacramento

BUREAU OF EDUCATION AND RESEARCH.

DR. H. C. BRYANT, In Charge	Berkeley

BUREAU OF PUBLICITY.

ROLIN G. WATKINS, In Charge	San Francisco

BUREAU OF GAME FARMS.

AUGUST BADE, In Charge	**Yountville**

BUREAU OF SCREENS AND LADDERS.

JOHN SPENCER, In Charge	San Francisco

BUREAU OF RIVER AND HARBOR POLLUTION.

ROLIN G. WATKINS, In Charge	San Francisco

CONTENTS.

Page

LETTER OF TRANSMITTAL 7

IN MEMORIAM 8

REPORT OF EXECUTIVE OFFICER 9

- Patrol Department 11
- Fish Culture Department 12
- Commercal Fisheries Department 14
- Bureau of Finance and Accounts 14
- Bureau of Education and Research 15
- Bureau of Publicity 15
- Bureau of Pollution 16
- Bureau of Screens and Ladders 16
- Game Farm 17
- Bureau of Statistics 18
- Monthly Reports 19
- Cooperation and Acknowledgment 19
- Dollar-A-Year Wardens 20
- Plenary Powers 21
- Future Plans 22

DEPARTMENTAL AND BUREAU REPORTS—

- Department of Patrol — *J. S. Hunter* 26
- Department of Fish Culture — *W. H. Shebley* 33
- Department of Commercial Fisheries — *N. B. Scofield* 62
- State Fisheries Laboratory — *W. L. Scofield* 74
- Legal Department — *B. D. Marx Greene* 79
- Bureau of Education and Research — *H. C. Bryant* 82
- Bureau of Publicity — *Rolin G. Watkins* 89
- Bureau of Game Farms — *August Bade* 90
- Bureau of River and Harbor Pollution — *Rolin G. Watkins* 93
- Bureau of Finance and Accounts — *H. R. Dunbar* 97

APPENDIX—

- License Sales 99
- Violations of the Fish and Game Laws 103
- Seizures of Fish, Game and Illegally Used Fishing Apparatus 105
- Summary of Fish Distribution 106
- Fish Distribution by Counties and Hatcheries 107
- Lion Bounties 112
- Report on Catch of Fur-bearing Mammals 113
- Estimated Value of Pelts 113
- California Fishery Products 114
- Report on Fish Canneries 122
- Financial Statement 125

LETTER OF TRANSMITTAL.

San Francisco, June 30, 1926.

Honorable FRIEND WM. RICHARDSON,
Governor of California,
Sacramento, California.

SIR: In compliance with law we submit herewith a report of the business transacted by the Fish and Game Commission for the biennial period July 1, 1924, to June 30, 1926.

This report summarizes departmental and bureau reports submitted monthly to this Commission and is prefaced by the report of the executive officer covering in a general way the activities, accomplishments and needs of the Commission.

It is our pleasure to report to you a complete reorganization of this Commission intended to place the Commission upon a business basis. This, we believe, is reflected in the reports of the various departments and bureaus.

As usual, the appendix to the report contains statistical information, much of which has been collected and presented for the first time.

Respectfully submitted.

I. ZELLERBACH,
M. J. CONNELL,
RALPH H. CLOCK,
Board of Fish and Game Commissioners.

In Memoriam

During the biennium the Commission has lost the services, through death, of a former commissioner, George H. Anderson, and three of the oldest deputies and one of the youngest in point of service.

Tom W. Birmingham, who for many years was stationed at Red Bluff, died on August 13, 1924. He began service with the Fish and Game Commission in 1903.

Henry J. Abels died August 21, 1925, after continuous employment with the Commission since 1905.

William J. Moore of Napa died May 4, 1925, his term of service having begun in 1909.

Bernard Luttrell, after only a few months service in Siskiyou County was accidentally killed on October 12, 1925.

The constructive work of these men will live long after them and constitute a greater memorial than we can here express.

REPORT OF EXECUTIVE OFFICER.

Honorable Board of Fish and Game Commissioners
of the State of California,
San Francisco, California.

SIRS: On January 18, 1926, the Fish and Game Commission commenced its reorganization, and it might not be amiss to state the facts leading up to the change.

On May 5, 1925, Commissioner George H. Anderson resigned and Governor Richardson appointed Isadore Zellerbach of San Francisco to fill the vacancy. On December 1, 1925, Frank M. Newbert, for many years president of the Board of Commissioners, severed his connection with the Commission. Mr. Newbert throughout his term of office cheerfully devoted a large portion of his time to the Commission and originated numerous conservation measures. During his incumbency the Commission grew from a small organization to one with many employees and manifold duties.

Judge Ralph H. Clock of Long Beach was appointed by Governor Richardson to take Mr. Newbert's place on the Commission. On December 7, 1925, Mr. Zellerbach was elected president of the board. On December 31, 1925, the then executive officer, George Neale, resigned.

Prior to this time the patrol of the state had been divided into three main subdivisions, one centering out of Sacramento with the executive officer in particular charge, one out of San Francisco and one out of Los Angeles. The wardens in each of these districts were accountable to a chief deputy in the district office functioning under the resident Commissioner. In addition there was a separate patrol, both land and water, under the Department of Commercial Fisheries, responsible directly to the Commercial Fisheries' office in San Francisco. The main patrol activities of the Commission were thus divided into three separate patrol districts. There were two other departments of the Commission—the Department of Commercial Fisheries and the Department of Fish Culture. The operation and supervision of screens in irrigation canals and fish ladders over dams were under the Department of Fish Culture. Pollution problems were handled in tidewaters by the Department of Commercial Fisheries, and in fresh water by the Department of Fish Culture, or by one of the three district offices of the Commission. The water patrol of the Commission in tidewater and on the ocean was under the Department of Commercial Fisheries, and the fresh water patrol in the upper Sacramento and San Joaquin rivers was under the Sacramento district office, without any relation or cooperation between the two patrols and under an arbitrary division of territory. Each of the three district patrol offices of the Commission was a separate entity, self-governed, and responsible solely to the Commissioner resident in that district.

On January 18, 1926, the Board of Commissioners met and appointed the present executive officer upon a program calling for an entire reorganization of the Commission. It was determined that the Commission should function as a business concern, with a similar form of management, centering all responsibility exactly where it belonged; that the three Commissioners should serve in exactly the same capacity as the directors of any modern corporation, fixing the broad general policies of the Commission, and divorcing themselves entirely from the administrative and executive work which theretofore had been handled by each Commissioner for his own particular district; and that the Commissioners should act collectively as a Commission, and that no individual Commissioner should have the right to determine policies or direct the actual functioning of any department or employee of the Commission.

The executive officer was to have the same status in the Commission as the general manager of a corporation with all functions of the Commission centering in him. In order to do this effectively it was determined that all activities of the Commission, other than those of the three main departments, should be handled by bureaus, each directly responsible to the executive officer.

Inasmuch as the present executive officer had been acting as attorney for the Commercial Fisheries Department, it was deemed best in the interests of economy and efficiency to combine the three offices (executive officer, attorney, and attorney for the Commercial Fisheries Department) in one individual, and that the executive officer should be given an assistant attorney to aid him in his duties. In view of the fact that the new executive officer was to act as general attorney for the Commission and handle the legal work for the Commercial Fisheries Department, it was deemed necessary to remove the executive offices from Sacramento in order that the executive officer might be in close touch with the Commercial Fisheries headquarters in San Francisco. Also, it was decided that the executive offices must be closer to Mr. Zellerbach, the new president of the board, who was taking such an active part in the work. With a new assistant executive officer, Mr. Dunbar, at Sacramento, sufficient contact could be maintained with the Board of Control and the Civil Service Commission. The organization was built up, then, in three main departments:

Patrol Department.
Fish Culture Department.
Commercial Fisheries Department,

and the following bureaus:

Finance and Accounts.
Education and Research,
Publicity,
Pollution,
Screens and Ladders.
Game Farm,
Statistics and Game Problems.

Monthly all the department and bureau heads assemble for a cabinet council meeting at headquarters in San Francisco. At these meetings general matters of policy are discussed and cooperation between the departments planned and consummated. Certain fixed cabinet policies are adopted for our mutual guidance and matters are frequently referred to the Board with our recommendations. The executive officer is thus guided by the opinion of those entrusted with the detail workings of the various activities of the Commission.

To supplement the cabinet meetings a system of interoffice correspondence has been worked out. All matters of a technical nature coming in the mail or otherwise to the executive officer are immediately referred to the head of the department or bureau particularly interested. Instructions are given with the transmittal that the letter shall either be answered directly by the chief of the department, or that a report be made and forwarded to the executive officer so that he may personally reply. It frequently happens that transmitted matter passes from the executive officer to the Patrol Department, thence to the captain of patrol, from him to the deputy patroling the particular district where the investigation is to be made, and then the report from that deputy comes back through the usual channels to the executive officer. Fixed responsibility is therefore placed and an intelligent answer can be made to the original correspondent.

It was intended to make the Fish and Game Commission function as a big business concern, and we have endeavored in every possible way to avail ourselves of advanced business methods. Modern office furniture and fixtures have been installed. A power multigraph machine eliminates much printing. Roll top desks have been abolished. Supplies are purchased in large quantities instead of piecemeal as heretofore by branch offices and departments. A new card system inventory is being prepared and will be kept up to date. A personnel file is being installed as a basis for increases in salary and promotion.

The general duties and scope of activities of the three major departments of the Commission are as follows:

PATROL DEPARTMENT.

The first step in the reorganization of the Patrol Department was to abolish the local district offices. All of the patrol, land and water, with the exception of one boat working under the Commercial Fisheries Department at San Pedro, was centered under a chief of patrol. J. S. Hunter, who had for many years been in charge of the district office of the Commission at San Francisco, was selected as the new chief. His report appended shows in more detail the organization of his department. It is pleasing to relate that real efficiency in patrol is now being obtained.

Mobility of men is possible, and deputies can be massed in portions of the state when and where needed. Extra men can be put on for the opening of the deer and duck season. When emergency arises details can be shifted from one portion of the state to another. The captain system as instituted in the patrol has been a big success. One feature of the new system which deserves particular comment is the cooperation which this department lends to all other departments or bureaus of the Commission. This year the captains and individual deputies have assisted, when called upon, in the planting of fish; in like manner they have made reports on pollution, and on screen and ladder matters.

FISH CULTURE DEPARTMENT.

The detailed report of this department, which functions as heretofore under W. H. Shebley, the dean of all employees of the Commission, shows its manifold activities and ramifications. Without screens, ladders and pollution, which are now in separate bureaus, this department of itself is still one huge business enterprise. New hatcheries are being constructed: fish ponds are being built: and new theories are constantly being tested.

During the coming year a radical departure will be made in the method of planting fish. Heretofore, prior to the fish planting season, individuals, sportsmen, organizations, boards of supervisors, forest service and others have applied to the Commission for allotments of trout. As far as possible, the Fish Culture Department honored these applications without any possibility of determining whether applicants had proper facilities for transporting and planting the fish. The consequence has been that for years the Commission has been blamed—for the most part unjustly—for poor planting methods. The receiving of fish from the Commission had become a right rather than a privilege, and if the applicant were not given his requested allotment, an uproar ensued. A study of the situation showed clearly that it was as much the duty of the Commission to see that the fish were planted properly as it was to rear healthy fry. There is no question but that our Fish Culture Department is as efficiently managed as any in the country, and that the taking of eggs and raising of fish is being conducted by a man who is a past master in the art, and it has been a crime and a shame that these fish after leaving the skillful hands of our own fish culturists, should be improperly planted, lost or destroyed, through inexperienced or inefficient methods of handling.

To remedy the situation an order has been issued by the executive officer that the Commission will no longer receive any applications for fish. Prior to the next fish planting season the Fish Culture Department will send to each of the patrol captains of the state a communication giving an initial estimate of the number and species of fish which can be alloted to that district for the next season. Thereupon the patrol captain will call into consultation those people in his district who have heretofore received fish from the Commission, his own deputies and such other persons as he deems interested. This conference, armed with maps and all available data, will designate and allot to each stream and lake within that patrol district the proper number and species of fish. These proposed plantings will be designated as either primary or secondary. The report will then be forwarded by the patrol captain to the Department of Fish Culture, together with a designation of places within the district at which the captain desires to receive the fish, and the quantities for each destined point. From their knowledge of the biological or other situations in the streams and lakes, the Fish Culture Department will check these reports over for accuracy as to designated plantings. Thereupon, when the Fish Culture Department knows with certainty the number of fish available for planting during the season, the captain of patrol will be notified whether his allotment will be made in full or cut. If it is cut, the secondary plantings will be diminished. When the planting season begins the Fish Culture Department will notify the patrol captain of the day of arrival of fish at points of destination and the number shipped. The patrol captain and his deputies in the meanwhile will have arranged with local sportsmen's associations and other interested parties, the question of transportation and volunteers to assist in the planting. The distribution cars upon arrival will be met by the deputies and planting crews, and the planting will be done under the direction of the deputies, with the full responsibility resting upon them. In this way it is hoped that fish will be alloted to streams and lakes rather than to individuals.

It is a radical departure, but from all indications it is a popular change, and we believe that with the support of the sportsmen of the state it can be put over and redound to the credit of our fish planting system.

At the urgent request of the sportsmen of California, this Commission early in the year 1926 commenced the construction and maintenance of so-called retaining or holding ponds for trout. The argument advanced in favor of these ponds was that the planting of very small fry resulted in their destruction by predatory fish, and that if the trout were held until they reached the size of 4½ or 5 inches, they would have a far better chance after liberation. The Commission has constructed holding ponds adjacent to several of its fish hatcheries, and the fish have thrived and will be liberated during the fall and winter months. In addition to these ponds constructed by the Commission, over which it retains the supervision and care, the Commission has cooperated with the sportsmen's organizations of the state in the building of other ponds by furnishing plans and aiding in the choice of sites. These ponds have then been constructed by the sportsmen out of their own funds. They have also arranged for the feeding and care of the fish. In all over two and one-half million trout have been placed in these ponds. The utmost cooperation has been extended to the Commission by the sportsmen, and our Fish Culture Department has, likewise, extended to the sportsmen its help, supervision and advice. The experiment, however, in regard to most of the ponds built by the sportsmen has resulted most unfavorably. It has been fully demonstrated to us that it is the duty of the Fish and Game Commission not only to hatch the fish originally in our hatcheries, but to rear them until they are actually planted. It takes a fishculturist to care for fish in holding ponds just as much as in the trough at the hatchery. The sportsman, no matter how well intentioned, except in rare cases, can not give to the fish in the holding ponds the trained care and attention necessary. Disease is just as prevalent among young trout in holding ponds as it is in hatcheries, and firm, immediate and scientific methods are necessary to combat disease when it appears.

It is the opinion of the executive officer that this Commission should proceed with holding ponds, and should construct them at our hatcheries and at strategic locations throughout the state; but I firmly insist that all of these holding ponds shall be constructed by the Commission and maintained by the Commission out of its own funds, and under the care of our own Fish Culture Department. As many of the ponds as possible should be so-called natural ponds where the young fish can obtain their own food. The question of feeding a large number of fish in ponds until they reach the size of five inches is at the present time completely beyond the finances of the Commission. We will have to go slowly until further funds are available. It can therefore be stated that the theory of holding ponds is successful when they are maintained under our own auspices. I can not conscientiously recommend that any fish be furnished by us to sportsmen's organizations unless those sportsmen definitely commit themselves to the employment of trained fish-culturists to take care of the fish.

COMMERCIAL FISHERIES DEPARTMENT.

This department continues to function with its usual efficiency under the capable leadership of N. B. Scofield, who has been its head since the inception of the department many years ago. The department retains all of its former functions with the exception of the water patrol of San Francisco Bay and pollution of tidewaters. The detailed report of Mr. Scofield is attached showing his trials and tribulations in the strenuous war with those who sought to ruin the fisheries of this state by the unrestricted use of food fish for fertilizer. In this connection it would not be amiss to point out that the success of Mr. Scofield in his efforts to conserve our fish has been in a large measure due to the unswerving backing of all our Board as it unequivocally took the stand that the fish of this state must be saved.

Mr. Scofield's signal ability and attainments as a scientist have been recently recognized in his appointment by Secretary of Commerce Hoover as a member of the Advisory Board of the U. S. Bureau of Fisheries, and in his appointment by the President of the United States to the position of Commissioner on the International Fisheries Commission between the U. S. and Mexico. This International Commission is working in the utmost harmony with our Commission and has placed in our laboratory at San Pedro a corps of workers who are collaborating with our laboratory assistants in scientific work relating to commercial fisheries.

The various bureaus of the Commission function as follows:

BUREAU OF FINANCE AND ACCOUNTS.

This bureau has charge of the issuance of licenses and of all accounting and funds of the Commission. H. R. Dunbar, as its head, was promoted from cashier to assistant executive officer, so that he could relieve the executive officer of financial details and act as a liaison officer between this Commission and the other state departments at Sacramento, such as the Board of Control. To him is entrusted the workings out of the finances of the Commission under the new accounting method installed for us since reorganization by the Board of Control. At this time I desire to express to the Board of Control my personal appreciation and the appreciation of this Commission for the very valuable work done for us by their accountant Richard Soberanes, who was with us for a period of six months, and the full cooperation extended to us by all members, officers and employees of the Board of Control.

This new bureau has now worked out a simple efficient method of accounting, which allows every department and bureau head to know at any time the exact state of his finances. This heretofore had been completely impossible owing to cumbersome, antiquated methods. A rigid budget system has been installed and each department and bureau is on a definite yearly allowance, checked by quarterly estimates of needs. I am happy to say that the first six months' experience since reorganization has shown that we were able to keep within our budget allowance.

BUREAU OF EDUCATION AND RESEARCH.

This bureau formerly included in its scope the publicity work of the Commission, but under the reorganization this has been delegated to a separate bureau. The bureau remains under the able leadership of Dr. H. C. Bryant, and now devotes itself entirely to the educational program of the Commission and such research problems as have to do with vertebrate zoology and food of birds and animals. The work of the bureau has been facilitated by extending to it increased financial allowance, so that Dr. Bryant now has a regular assistant who can aid in his lecturing and act as librarian for the Commission. This bureau has already purchased the best of the available motion picture films of California fish and game subjects, and is publishing educational booklets as rapidly as possible. The reorganized Commission lays great stress upon its educational campaign, and as time goes on we expect to increase greatly the scope of this bureau. Our plans contemplate the removal of the bureau's headquarters from Berkeley to the San Francisco office of the Commission in order that its library and other data and material will be available for the use of the officers and needs of the Commission, and so that the executive officer and other branches of the Commission may keep fully in touch with our educational program.

BUREAU OF PUBLICITY.

For many years the Commission has suffered through lack of proper publicity. A large portion of the publicity contributed mainly through unauthorized channels was termed propaganda by the newspapers and promptly turned down. Our first effort, therefore, was to secure a real newspaper man to head this important branch of our work. We were fortunate in securing Major Rolin G. Watkins, who is a specialist along this line, and he has ably conducted this bureau. His detailed report is appended and shows how we are reaching the people of the state. Formal instructions have gone to all departments and employees of the Commission that no publicity must emanate from any of them without going through the executive office to see that it is consonant with the policies of the Commission. We are thus able to centralize responsibility and the policy of the Commission is not jeopardized. Major Watkins' sole instructions in his publicity work were to tell the people of the state what we are doing and what we expect to do in the future and to avoid anything in the nature of propaganda. It has been his principle, therefore, to write stories of activities carrying a human interest value.

To build up the morale of the employees of the Commission, to unify the personnel and to infuse a spirit of pride in being a part of a large organization that is doing things, it is part of the duty of this bureau to get out once each month a "Service Bulletin," which is mailed to every employee of this Commission. Through the Bulletin, also, all departments issue instructions or give items of particular interest.

BUREAU OF POLLUTION.

Until such time as the Commission had additional funds it was deemed best to consolidate this bureau with the Bureau of Publicity under Major Watkins, and it has functioned ably. As previously noted, it takes over from the Department of Commercial Fisheries and the Department of Fish Culture and the former patrol districts, this ever-present problem which seems to be getting so acute throughout the state and nation. Major Watkins can not be commended too highly for the able manner in which he has conducted the bureau. The most gratifying feature of the work has been the results accomplished by persuasion without court procedure. Sore spots of the worst character have been remedied, and in many cases, obliterated.

BUREAU OF SCREENS AND LADDERS.

At the head of this bureau we have placed a trained hydraulic engineer, John Spencer. The creation of the bureau was deemed necessary because the work of the Department of Fish Culture has grown so enormously within the past few years that it is absolutely impossible for that department to put into this important feature the necessary time and energy. It is almost unbelievable when I say, conservatively, that there should be at least three thousand installations of screens and ladders in California; probably at the present time not more than six hundred have been installed, and of these it is doubtful if more than 50 per cent are functioning adequately.

Early in April a conference was called at the executive office, to which were invited representatives of all power companies and irrigation districts in California, for a free discussion of the screen and ladder problem to the end that committees could be appointed by those interested in such installations to help the Commission devise standard forms, hereafter to be adhered to. The conference was well attended and resulted in the formation of two committies, each of five members, one composed of those interested in power development, and the other of those interested in irrigation matters. These two committees are cooperating with the head of the bureau and we believe they will aid us materially in the solution of our problem.

Large sized maps have been procured for the bureau, old records have been delved into, and the head of the bureau has card indexed the situation thoroughly and is graphically showing upon the maps all installations and their present condition. Surveys are being made as rapidly as possible all over the state, and the cooperation of the patrol, through the individual deputies, is gradually bringing to this bureau the information necessary on which to base an aggressive campaign during the coming spring.

Incidentally, experiments are now being carried forward for the first time, we believe, in the United States, to determine once and for all whether nonmigratory trout, such as rainbow and eastern brook, are carried down the canals and through the turbines of power companies. Racks and traps have been installed below Hat Creek No. 1 plant of the Pacific Gas and Electric Company and in cooperation with the U. S. Bureau of Fisheries, and with the assistance of the associated sportsmen, our Commission is making an observation extending over an entire year to determine how many fish are carried through the power plant, and the cause of death in each instance. Our biologist makes post-mortem examinations of all fish caught. This information will be of great value.

GAME FARM.

Shortly after Mr. Zellerbach became a member of the Commission it was brought forcibly to his attention that California had lagged behind in the construction and maintenance of game farms. He thereupon made a trip to Oregon and Washington and investigated the operations of game farms in those states. He came back to California imbued with the idea that California must put herself upon a par with the other western states, and he succeeded in obtaining from the Governor and the Board of Control an extra appropriation of $50,000 to be devoted to the purpose of establishing a game farm. The only other experiment in game farming which had ever been carried on in California by the Commission was that at Hayward, some ten years ago, which had been abandoned for reasons which I am unable to understand. Through the good offices of the Board of Control, a site was leased from the state near Yountville, in Napa County, on the grounds of the state farm. To oversee the construction of the game farm and take charge of it after completion, the Commission employed August Bade, who had made a great success of similar work in Washington. Through the generosity of our sister states of Wash-

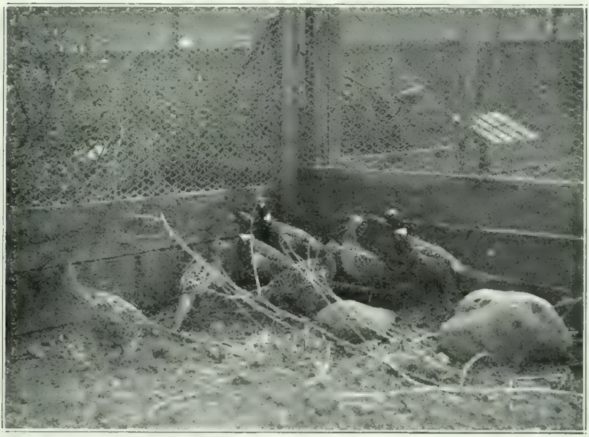


FIG. 1. Pen of five months old ring-necked pheasants reared at the State Game Farm, season of 1926. The hatch for the first season was all that could be expected and favorable reports are being received of the plants made. Photograph by H. C. Bryant.

ington and Oregon, certain pens of brood stock were donated to the Commission. Other brood stock was purchased and under the infinite difficulties of raising birds during the construction period, the first real California Game Farm completed its initial year. The report of Superintendent Bade is appended and shows the results attained.

Having learned by bitter experience through our fishcultural operations that it is unwise to have planting done by organizations or individuals who have not had the proper advance training, it was early determined that all planting from the game farm should be done under the strict superintendence of our trained employees. Also, all applications for birds from organizations or individuals were referred to Superintendent Bade with instructions to visit the localities referred to and pass his own unconditional judgment as to suitability. After suitability had been determined, an investigation was then made as to the proper protection for the birds. In no instance has the Commission made a planting unless a large area (in most instances not less than twenty thousand acres) had been set aside by the owners as a refuge. Also, no small plantings were made; the average number of birds to each planting was one hundred and fifty. We are happy to say that our plantings were uniformly successful. The loss of birds was practically nil, and the splendid spirit of the sportsmen and of the justices of the peace have shown poachers that the killing of our planted birds will bring real punishment. We feel that we are warranted in saying that our game farm represents the best that money and intelligence can do in construction work, and that our system of planting can not be bettered. While during the first year we have restricted our planting to pheasants, it is hoped that next year will see our initial planting of quail from brood stock which we have raised this year, and that we will also raise a goodly stock of Hungarian partridges from the twenty pair so kindly loaned us this year by the state of Oregon.

BUREAU OF STATISTICS.

For many years the Commission has been gathering data on fish and game problems which has reposed in our files and desks secure from the light of day. The one exception has been the Department of Commercial Fisheries, where the scientific work of the laboratory has been offered to the public in the form of bulletins and other contributions. To collate and make this information available the Commission has established a bureau in the Patrol Department in charge of R. E. Ludlum, an expert statistician and a student of fish and game matters. It is the function of this bureau to prepare statistical information of the many activities of the Commission, such as fur-bearing animals, trappers, mountain lions, game breeders, and other cognate subjects. In addition, the head of the bureau has charge of the investigation of all bird and animal diseases, and in this work he is fortunate in having available to him the full facilities of the Hooper Foundation of the University of California. At this time I desire to express to President Campbell of the University of California, the Board of Regents, and to Dr. Karl F. Meyer, head of the Hooper Foundation, our cordial appreciation of their cooperation and whole-hearted proffer of facilities for our research work. Dr. Meyer is personally taking charge of the laboratory end of this work, and I have assigned to the work in his laboratory Robert J. Irvine, our chemist and bacteriologist. Mr. Ludlum will handle the field work, through our deputies, in securing specimens and keeping in touch with the general situation, while the actual laboratory work will be done in the University of California laboratories. Post-mortems will be performed on all birds and animals that die in California when such cases are brought to our attention, and an intensive study is being made of epidemics which may arise at our game farm. We understand that this type of work which we are carrying on is entirely original, and may yield results of great value to the entire country and, perhaps, to other nations.

MONTHLY REPORTS.

Upon assuming office it was immediately apparent to me that there was very little information on hand as to previous activities of the Commission other than the quarterly Fish and Game magazine. The first order, therefore, issued to department and bureau heads was that a monthly written report must be submitted. These are bound in a loose-leaf book, and at any time it is possible to learn in detail of all of the past activities of the Commission. Monthly a full set of these reports, accompanied by a written report of the executive officer, is forwarded to each of the Commissioners. It is my purpose at the close of the fiscal year to have these monthly reports bound into a permanent book, to take their place among the records of the Commission.

COOPERATION.

It is with the utmost pleasure that we are able to state that at the present time this Commission is working in the greatest amity with every bureau and department of both the state and federal governments. For example: The disagreements of many years between us and the Department of Interior relative to a hatchery at Yosemite Valley have been eliminated. A lease satisfactory to both has been executed and the hatchery is under actual construction. Furthermore the park officials are cooperating with the Commission in the enforcement of our fish and game laws, are requiring all hunters and fishermen to have licenses, and will adequately police, and conduct the visitors through the new hatchery when built.

A new cooperative agreement has been drawn up with the Forest Service under which they enforce our fish and game laws, and we render service during periods of forest fires.

The Board of Control has rendered us every assistance in installing a new system of accounting, and aids us in every particular when called upon.

The Civil Service Commission has reclassified our entire patrol so that now all of our wardens are under civil service.

The Division of Water Rights is helping us in our screen and ladder problems by referring to us all applications for the diversion of water.

The Motor Vehicle Department aids us in tracing licenses of automobiles where there have been infractions of the law.

Last, but not least, it is our great pleasure to record that the Commission is now working in the utmost harmony with the sportsmen of the state. The commissioners and the executive officer have addressed numerous meetings of sportsmen from Siskiyou to San Diego, and everywhere we are assured, by word and deed, of hearty cooperation. New organizations of sportsmen are springing up like mushrooms throughout the state. We are informed that the Associated Sportsmen's Clubs alone represent an organization of 30,000 members. There are numerous branches of other organizations, and in each instance there is now such a spirit of amity between them and the Commission that any criticism received is constructive in its nature.

We might note the cordial relations existing between this Commission and the Fish and Game Study Committee of the California Development Association. This committee was formed as the direct result of the annual meeting of the Associated Sportsmen held in December, 1925, and consists of representative men from all parts of the state who have been devoting their time and energy toward a study of laws and methods necessary to better our fish and game conditions. This committee holds periodic meetings and they have been most generous in requesting the cooperation of the Commission to help them in their deliberations. Their recommendations as made are being referred to this Commission for criticism or suggestions, and we appreciate such cooperation and feel sure that they are doing a work which will redound to the credit of us all.

Again, as in years past, we wish to record our grateful appreciation of the many courtesies extended to us by the railroads of the state in the free transportation of our employees, fish, and game birds. This splendid cooperation on their part has helped in a large way toward the restocking of our lakes, streams and hunting grounds. The savings thus effected have enabled us to increase our plants, both of fish and game, and in this way the transportation companies are doing their share to make more attractive the outdoor life of this state.

DOLLAR-A-YEAR WARDENS.

For the purpose of aiding the regular patrol of the Commission we are now appointing so-called dollar-a-year wardens. To secure such appointment a man must be recommended by a regularly constituted sportsmen's organization. Thereupon his qualifications are gone into by a special agent working out of the executive office. If he is passed upon by that special agent he then, with his fellow members in that district, receives instructions from this special agent upon his duties. The duty of this special agent is to see that the dollar-a-year men cooperate fully with the patrol of the district. The dollar-a-year men select their own captain, and through this captain, the captain of the regular patrol draws on the sportsmen's deputies when needed. The dollar-a-year deputy can not function outside his local patrol district, except to arrest for an offense committed in his presence, unless he receives clearance from his local captain of patrol to the captain of the district of the state which he purposes to visit. Approximately 200 of these dollar-a-year wardens have been appointed and where they have received instructions from the Commission and are operating with the regular deputies, they are performing exceedingly valuable service. It is apparent that the system can be a success if it is governed by rigid rules in regard to the original selection of the deputies, and if these deputies work with the regular patrol and not independently. A deputy can not be made by giving a man a commission, a written manual of instructions and authorizing him to put a gun on his hip and wander at large over the State of California. This Commission frowns upon technical arrests; and deputies, both regular and volunteer, must be armed with discretion rather than shooting irons. The Commission can get into hot water just as quickly through irregular practices of a volunteer warden as by the acts of its regularly paid wardens. As rigid rules must govern volunteer wardens as govern regular wardens, otherwise our entire system of their selection and authorization will fall into disrepute. I am strongly of the opinion that the dollar-a-year warden service will prove a success, but it must be carefully watched and its rules must be rigorously enforced.

PLENARY POWERS.

It is apparent that this Commission can not properly function unless it has additional powers. These are usually called "plenary powers" but the name is perhaps misleading. As is well known, the constitution of this state gives the legislature the right to divide the state into fish and game districts and to pass legislation appropriate to those districts; consequently there is a period of two years after the meeting of each legislature during which it is impossible to change districts, or seasons, alter bag limits or take any immediate steps necessitated by drought or other exceptional conditions. If the forests, for example, are so dry that it is dangerous for hunters to enter, it is beyond the power of this Commission to declare a closed district. Similarly, if drought conditions dry up streams to a danger point, we can not forbid the public from fishing. Also, if we plant small tributary streams we can not stop fishing until the fish mature. We can not close off portions of lakes, as Oregon does, where they allow no fishing at all so as to constitute a fish refuge, which is just as essential as a game refuge. Abnormal water conditions may dictate that it is necessary to curtail the duck season, or to open it later than the law at present allows. The Fish and Game Commission has no power to make any such rules.

In my opinion legislation should be immediately enacted which will give the Commission power, after proper hearings, to curtail seasons, to diminish the bag limit, to close streams, and generally to safeguard our fish and game. There is a question in my mind whether the legislature has the power or authority to delegate these duties and rights to the Fish and Game Commission.

I therefore suggest that a bill be prepared and presented to the legislature giving us these powers, and that there be presented also to the legislature a constitutional amendment with the same purpose. In the event that the legislature passes the bill requested, a test case can be brought to see whether or not it is constitutional. If the courts declare it unconstitutional, then the matter can be brought before the electors by a constitutional amendment at the next general election in November, 1928.

It is significant that our sister state of Oregon enjoys plenary powers, and those powers have been exercised with such discretion that they are in favor with all concerned. Many of the middle western and eastern states have similar powers, and California has lagged far behind in these matters.

FUTURE PLANS.

A detailed study of the financial exhibit attached to this report will show that at the present time the Fish and Game Commission is annually spending more money than its actual revenue. This is only possible because we at present have a surplus on which to draw. At the expiration of the biennial period commencing next July, our surplus will be reduced to approximately $200,000. At that time the Commission will have to prune its budget to its revenue or obtain further funds for we can not further dig into our surplus except for permanent improvements or emergencies. If the budget is diminished, many of the new bureaus and activities of the Commission will have to be curtailed. A careful census of public opinion has been made by the Commissioners and the executive officer to determine how the sportsmen feel toward a raise in license fees and, uniformly throughout the state without exception, at meetings and otherwise, we are told that the Commission, now having established itself in the confidence of the public, is entitled to a raise in licenses so that it may continue to function and increase its activities.

A study has been made to determine the effect on the number of licenses issued by a raise in the license fees, and I am of the opinion that the maximum return with the least loss of privileges to hunters and fishermen can be secured through a license fee of $3 for angling, $3 for hunting, a combined license of $5 for both, a $1 angling license fee for children from fifteen to eighteen, and $1 for certain types of salt water fishing. This increased license fee will furnish us with sufficient revenue to provide for, our present needs and necessary expansion.

A budget has been prepared showing how this increased revenue would be spent. One hundred and seventy-five thousand dollars is necessary for the salaries and expenses of fifty new deputies. New hatchery operations will entail an annual expenditure of $50,000. (During the coming year there will not be sufficient money in the Fish Culture Department's budget to allow for the operation of all of our new hatcheries.) A new game farm will be built in southern California which will cost us $15,000 annually. The Commercial Fisheries Department must extend its laboratories and other facilities. If our upland birds which we propose to plant from our game farms are to thrive and multiply, it is absolutely necessary that game refuges be installed under a system similar to that of Pennsylvania. This is estimated to cost at least $175,000 per year for the purchase, posting and protection of land.

Eventually this Commission must build up its own crews for the planting of fish. We can not expect sportsmen forever to loan us pack animals and men to carry fish to lakes and streams throughout the state, sometimes as far as the summit of the Sierra Nevada mountains. To establish such a system it is estimated that at least $100,000 will be required annually, and as I have said before, even now there is an annual deficit of almost $100,000 which must be cared for in the increased license tax.

From one end of the state to the other we are beseiged in late summer and fall with communications telling us of the drying up of streams and the stranding of trout. The Commission has no fish saving crew or outfit. One of our necessities is the installation of a mobile system which can proceed quickly to any such place, seine the fish, put them in cans and transport them to available waters. This will entail the employment of men and the purchase of equipment. We have neither available at the present time. The situation must be taken care of. The plans are worked out and if we can get our increased license tax we can cope with the situation.

As our fine highways from year to year further extend into the high mountains, it becomes increasingly apparent to our anglers that there are numerous barren lakes and streams, and we in the Commission realize that fact from the constant inquiries made to us calling our attention to lack of fish in many places. We have at the present time one biologist working in the Fish Culture Department attempting to make a survey of all our lakes and streams. Other states have encountered the same problems and we find in reading their reports that they have set up entire departments to handle the situation, with a corps of trained assistants and adequate money.

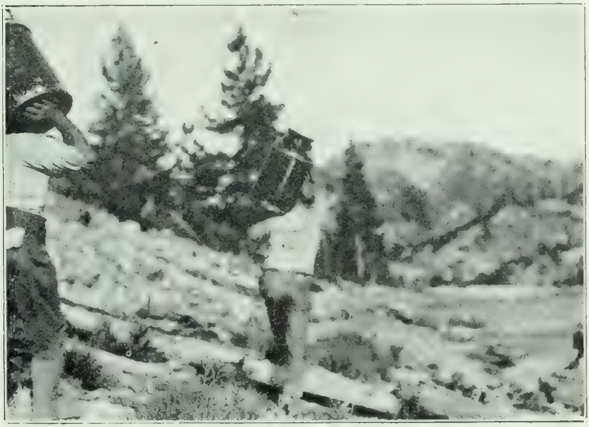


FIG. 2. Fish from California hatcheries being moved from auto truck to mountain lake by members of the Grass Valley Sportsmen's Club, August 1, 1925.

It is necessary to make a thorough biological survey of all lakes and streams to determine the species that thrive best there, and the plentitude or lack of proper fish food. This is a matter which will take years; but as our nearby lakes and streams are becoming more and more exhausted, it is apparent that we must concentrate on the other portions of the state where fish can be planted and make the supply somewhat approach the actual demand. It will be an expensive and a long process, but we are face to face with a crisis in our fishing conditions and we might as well face it right now. An adequate survey should be started immediately and we must secure the extra funds. It will cost at least $15,000 annually.

In closing, the executive officer desires personally and on behalf of all his colleagues, to express to Governor Richardson and to you, Mr. Zellerbach, the president of the Commission, and to Mr. Connell and to Judge Clock, its members, and to all other employees of the Fish and Game Commission, our appreciation of your whole-hearted support and cooperation. What little success we may have attained in reorganizing the Commission has been due to the cooperation of the Governor and to the untiring work and energy both of the Commissioners and of every single member of the various departments and bureaus of the Commission. I have made it my task to travel over the state from north to south and from east to west to meet our deputies and others on the ground, to look into the various activities of the Commission and to get a first-hand comprehensive view of the situation. I am impressed by the splendid personnel which has been built up over a long period of years. I wonder at the self-sacrificing attitude of our deputies and other employees. It is incomprehensible that these men have stayed with the Commission from year to year on a salary less than that which is paid to the ordinary policeman upon his beat in the cities of San Francisco and Los Angeles. Our deputies are a fine, up-standing bunch of men, two-fisted fighters all, and men who have earned the respect and confidence of the districts in which they reside. We are all a happy family, working toward a common end, the conservation of our fish and game.

Respectfully submitted.

B. D. MARX GREENE,
Executive Officer

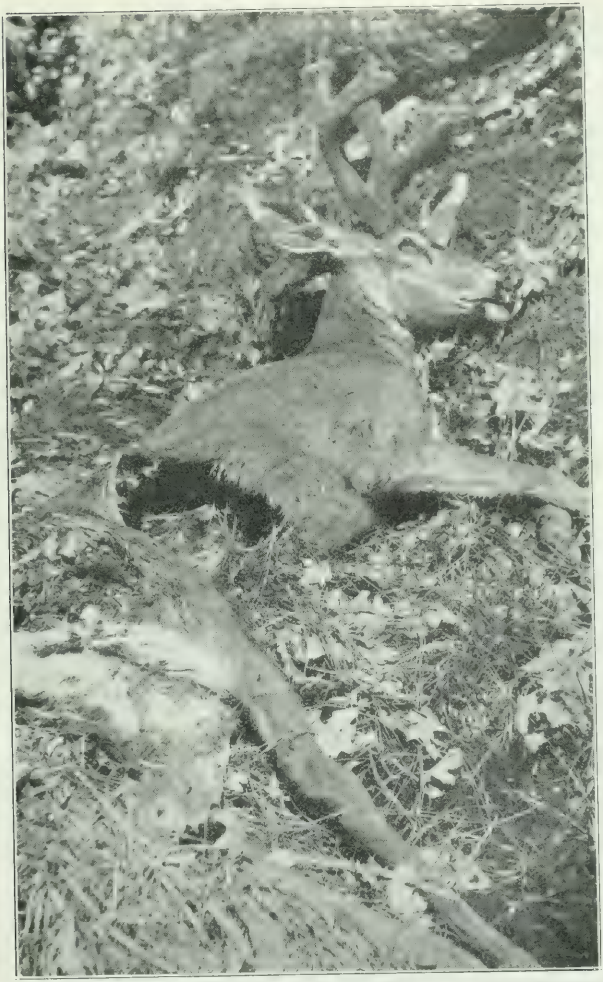


FIG. 3. Photograph of buck killed by mountain lion near Avery, Calaveras County. Lion hunter Bruce secured the culprit, a male mountain lion, a quarter of a mile from the kill. Photograph by Jay C. Bruce.

DEPARTMENTAL
AND
BUREAU REPORTS

REPORT OF THE DEPARTMENT OF PATROL.

By J. S. HUNTER, Chief of Patrol.

With the reorganization of the Commission at the beginning of the year 1926, a Department of Patrol was created. The entire patrol force with the exception of the salt water patrol, in southern California, was placed under one head, the chief of patrol. Previous to this, the state had been divided into three districts—San Francisco, Los Angeles and Sacramento. The deputies in these districts were responsible to their superiors in the respective offices. In many instances it was found that the best results could not be secured through this system. There was a lack of cooperation between the districts and lack of uniformity in the enforcement of many laws. The change was made in order that better and closer cooperation might be obtained and the laws enforced uniformly throughout the entire state. Under the old system it was impossible to keep close track of the work of the individual deputies. In order that every man might be under closer supervision, the state has been divided into patrol districts, with a captain of patrol in charge of the men in his district. The captains have been selected with great care and only men with years of experience and excellent judgment have been appointed. These captains work under the direction of the chief of patrol and in every way are held responsible for conditions in their district. It has been found that the men appointed captains are perfectly willing to assume the added responsibility and there is a greater incentive for the patrol deputies to do their work effectively for they realize that in time they may be promoted.

The boundaries of the patrol districts are at present more or less arbitrary and will be changed as experience shows necessary. In order to distinguish the patrol districts from the numbered fish and game districts, the former have been designated: northern California, Lassen, Sacramento Valley, Sacramento, San Francisco, northern San Joaquin, southern San Joaquin, southern California, Monterey, Sonoma and Humboldt. The very important district of San Francisco includes the bay and river patrol that was formerly carried on under the direction of the Department of Commercial Fisheries. It is believed that better enforcement of the laws will be had through the cooperation of the land and water patrol.

In order that the chief might be relieved of a great deal of the routine office work so that he could spend more time in the field, Deputy S. R. Briggs, who had been doing patrol work in the San Joaquin

Valley, was promoted to assistant chief and transferred to the San Francisco office. Mr. Briggs' field experience and education makes him well qualified for his more responsible duties.

Just before the close of the biennial period, a civil service examination was held to establish an eligible list from which deputies of the Commission could be selected. It was found that approximately one-half of the deputies employed were without civil service standing. Practically all of the men employed by the Commission passed the examination and were given the protection of civil service regulations.

In March, 1926, a convention of the deputies of the Commission was held in San Francisco. The men of the entire staff were brought together and were instructed by members of the Commission in their duties and informed regarding branches of our work of which they had little knowledge. It is hoped that we will be able to hold other conventions in the future, as much good results from such gatherings.

During the biennium deputies made a total of 1432 arrests for violations of the game laws and 1675 arrests for violations of the laws relating to fish. A total of $104,455 was assessed in fines together with 5093 days imprisonment. These figures show an average of over four arrests per day and an average income from fines for the fish and game protective fund of more than $143 for every day of the two-year period. These figures should show that wardens are on the alert for violations and that a determined effort is being made to adequately enforce the fish and game laws.

The study of the diseases and the causes of the reduction in abundance of our various species of wild life has been more or less neglected by the Commission in the past. A bureau has now been planned within the Department of Patrol, that will make a study of diseases and conditions affecting game animals and birds. We know that epidemics often cause a serious loss of life from time to time in domestic animals and that the study of these diseases has resulted in the saving of thousands of dollars. If the same methods, modified as necessity requires, can be adopted in controlling the diseases of wild animals, we shall accomplish much in wild life conservation. Hence, it will be the duty of the new bureau to make a study of everything that affects game in the field. In the past, deer have been subject to serious epidemics that have caused the death of thousands of animals. The duck disease that appears more or less regularly every year, kills possibly hundreds of thousands of birds. We know that there are diseases that affect our quail and greatly reduce their numbers. If these natural losses can be eliminated, there will be more game left for the sportsmen to harvest and more game to propagate in the field. This work offers great possibilities and should be carried on by the Fish and Game Commission of every state in the union.

The patrol department is cooperating fully with every other department of the Fish and Game Commission, particularly so with the Department of Fish Culture. Previous to the sending of fish to the various patrol districts, the captain of that district is notified, and when possible an experienced deputy receives the fish and accompanies them to the streams in which they are to be planted. The deputies have made a survey of the state and have reported the condition of the screens and ladders on the various streams. Similar cooperation has been carried on with the Bureau of Pollution. Minor cases of pollution are attended to by the captains or deputies themselves, but in serious cases of pollution by manufacturing plants, the head of the Bureau of Pollution is advised and outlines his own policy.

In many sections of the state, due to the lack of rain, there has been serious loss of trout on account of streams going dry. Whenever it has been possible the patrol force has rescued such stranded fish and planted them in living waters. This is a very important part of the work of the patrol department and will be carried on more energetically in seasons to come.

The Fish and Game Commission is an educational commission as well as a law enforcement body. We believe that more good will result through educating the sportsmen of the state and showing them that it is to their interest to respect the various conservation laws, than through the courts of the state. We are seriously opposed to technical cases. A technical case will do much more harm than good and in practically all instances makes an enemy of conservation rather than a friend. Serious violations must be prosecuted vigorously and it is only through the active support of the various justices of the peace of the state that this work can be carried on successfully. The game laws are more flexible in the penalties provided than almost any class of misdemeanors. The minimum fine for game cases is $25 and the maximum, $500. It rests with the court as to whether the maximum or mimimum fine is imposed. Flagrant and repeated violators should receive the maximum rather than the minimum fine.

At this time the patrol department wishes to thank the justices of the peace throughout the state for the most excellent cooperation that they have given. We need the help of every justice of the peace in our work.

California sportsmen have been more kindly considered by nature than have the outdoor men of any other part of the United States. While there are many thousands of square miles of fertile valleys where every branch of agriculture may be carried on, there are many more thousands of square miles of wild country that is not agriculture land, and which will be held in practically its primeval condition for years to come. Under wise conservation laws, strictly enforced, wild life will continue indefinitely.

Under sane management there is no need for any controversy between the agriculture and the sporting interests. Fields can be cultivated along side of wild land teeming with game; streams can be utilized for irrigation and power without detriment to the fishing interests, provided each problem is met with an open mind and a sincere desire to solve it in a manner that will work for the best interests of all the people.

The past two years have marked a distinct advance in conservation in our state. In general it can be said without fear of dispute that conditions are better than they were at the beginning of this biennial period. The most striking increase in game has been with valley and mountain quail. This is true in practically every part of the state. It is due, without doubt, to the change that was made in the law at the last session of the legislature when the season was limited to the month of December. The season comes at a time when it is difficult for many hunters to get into the field, when the birds are fully developed, after the rains have commenced and when the birds are no longer staying in the vicinity of the watering places. The law has shown that quail will respond very quickly to protective measures. Fortunately quail are rather prolific breeders. It is not uncommon for them to have two broods, and a second clutch will be laid in practically every instance if the first clutch is destroyed.

Due to the lack of rainfall throughout California, and in fact, throughout the entire Pacific coast, there has been a scarcity of ducks during the past two years. Last winter was particularly mild and great numbers of ducks are reported to have remained in the north. With the return of normal winters, duck hunting will improve and those who find their pleasure in the duck marshes will have no cause for complaint. Reports from other sections of the United States indicate that ducks have increased greatly since the federal law went into effect in 1913 and since uniform legislation has been provided for the entire country. The most urgently needed protective measure for waterfowl is a treaty with Mexico, similar to the understanding existing between our government and Canada as a result of the treaty made with Great Britain, with the proper means of enforcing the provisions of the treaty on both sides of the line. At the present time ducks are practically without protection as soon as they cross the southern line of the United States.

The epidemic of foot and mouth disease that broke out in 1924 was carried to the deer in Tuolumne County by cattle that were allowed to go through the quarantine lines into the mountain areas. Feed was so scarce in the valleys that it was deemed wise by the authorities to allow grazing in the mountains. Unfortunately, very shortly after the first lot of cattle went through the lines, the disease broke out. After very strenuous measures were taken by the federal authorities in charge of the control work, the disease was overcome but not until thousands of deer had been killed. The situation was so improved in the spring of 1926 that it was considered safe by the authorities to allow cattle from the valleys to again enter the restricted areas. It is certainly to be hoped that there will not be another outbreak of foot and mouth disease as it will not only endanger the deer of the state, but the entire live stock industry.

That deer will increase rapidly under favorable conditions is proved by the experience of R. O. Rampont of Ukiah. Mr. Rampont in the spring of 1921 secured a black-tailed doe fawn. In the fall of the same year, a buck was obtained and in the spring of 1922 another doe fawn. These animals were kept on his property in Ukiah in an enclosure covering somewhat less than half a city block. By the fall of 1925 from the start of two does and one buck, Mr. Rampont had a herd of sixteen deer. One of the does at the age of 15 months gave birth to a buck that was husky enough to grow forked horns instead of spikes the first year. This is more remakable when it is considered that the doe was only eight months old when mated.

California is to be congratulated on the results of its deer conservation. For over twenty years we have killed deer under a liberal season and limit. Many thousands of deer have been harvested each year. Notwithstanding this heavy toll, in most sections of the state, deer are as abundant as they were twenty-five years ago; in fact, the residents in many sections claim that they are even more abundant. The deer law is as nearly ideal as it is possible to have a game law. When you can separate a distinct class of animals which hunters are allowed to kill and which, in practically all instances, can be easily distinguished from the protected class, you have a law that will insure the maximum protection and utilization. The protection of does, fawns and spike-bucks insures a constant supply. Forked horns and larger deer can be easily distinguished. As long as this law remains and is enforced, our supply of deer is going to continue. The danger lies in the killing of the protected class by careless hunters who shoot without knowing at what they are shooting. If a doe or spike buck is killed, they leave it to rot in the brush. Such violators are extremely difficult to apprehend and can only be controlled by a considerable force of deputies throughout the entire deer section.

Spotlight hunting has increased and is the greatest menace to the deer at this time. Such hunters will kill does, fawns and spikes. They work on the principle that they are violating the law anyway and another violation will not add greatly to the offense. It is extremely difficult to devise a law that can be enforced that will put a stop to this illegal work, but it is believed that if a statute is adopted prohibiting the carrying of uncased rifles and shotguns in automobiles at night in sections frequented by deer, that much of the night killing will be eliminated.

Deer hunting with dogs has been severely criticized by many conservationists. There are many excellent arguments that can be made for and against the use of dogs in hunting. In most of the eastern states, dogs are prohibited. If it is deemed wise to further restrict the use of dogs, it might be well to consider a law that would provide that only small dogs be used. Such dogs would not be swift enough to catch, or large enough to kill a deer, but would be entirely satisfactory for "jump dogs" and for trailing wounded animals that would otherwise be lost.

The work of the Commission in the control of mountain lions has brought out many interesting facts regarding the distribution of lions in our state. A bounty on lions has been paid for nineteen years. During that time, 4680 lions have been killed. For the past eight years records have been kept of the number of each sex killed. These records show that 51 per cent of the lions killed have been males, and 49 per cent females.

There is every reason to believe that we are slowly but surely getting the best of mountain lions in California and that the number of animals killed is slightly better than the normal increase; but assuming that it is only the increase and knowing that the normal litter is only two kittens and that the female lions whelp every two years, then assuming that 255, the average kill for the biennial period, represents 49 per cent of the lion population of the state, we estimate that the total number of lions in California is approximately 520. These figures are 10 per cent less than a similar estimate made five years ago. A study of the accompanying cut will show where lions have been most abundant during the last nineteen years. The greatest number of lions, 2630, have been killed in the northwestern portion of the state, and of that number nearly 1100 have been killed in the humid coast counties of Mendocino, Humboldt and Del Norte. It would seem from this that the lion is not like other cats—afraid of water. It is also interesting to note that this section of the state is also the location of the greatest deer population. In the six southern counties only 254 lions have been killed, while in the counties east of the Sierras, Modoc, Lassen, Mono and Inyo, only 47 lions have been killed. Contrary to the general belief, lions are not abundant in any part of the state. Each animal must have a considerable range. The toll of deer taken by the lions in the state runs into the thousands. With the elimination of mountain lions, there will be many more deer for the hunters to harvest.

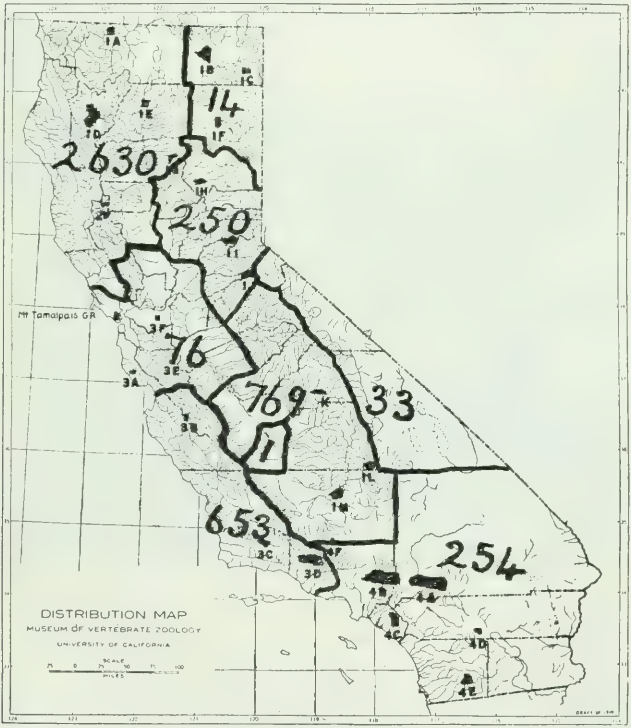


FIG. 4. Map showing the number of mountain lions killed in various districts of California. The north coast region furnished more than three times the number of lions taken in any other district.

The most encouraging evidence of the interest being taken in conservation by the general public is the organization of fish and game clubs in every part of the state. There have been many live clubs in various sections of the state in the past, but recently there has been a renewed interest and clubs have been formed in practically every county and the membership at present numbers many thousands. The Fish and Game Commission has carried on practically a lone fight for many years. There has been considerable help given by individuals, and by the few clubs that were in existence, but with the active support of the new organizations and the sincere desire on their part to bring about better game and fish conditions, much more effective work can be carried on. Already the clubs formed have sponsored the appointment of a considerable force of voluntary wardens who have been appointed as dollar-a-year men. These men will render valuable assistance to the regular deputies in their field work and will also be a great help in carrying out the educational work of the Commission to those who as yet do not realize that unless our conservation laws are enforced, the wild life of the state is doomed. It is only with the active support of every real sportsman that the Fish and Game Commission can do its best work.

REPORT OF THE DEPARTMENT OF FISH CULTURE.

By W. H. SHEBLEY, In Charge.

In conformity with the regulations of the Fish and Game Commission, herewith is submitted the report of the Department of Fish Culture for the biennium ending June 30, 1926.

During the two seasons covered by this report, the department has hatched and distributed 59,524,700 trout and 14,157,150 salmon. The salmon eggs were all collected from the salmon egg-collection station at Klamathon on the Klamath River.

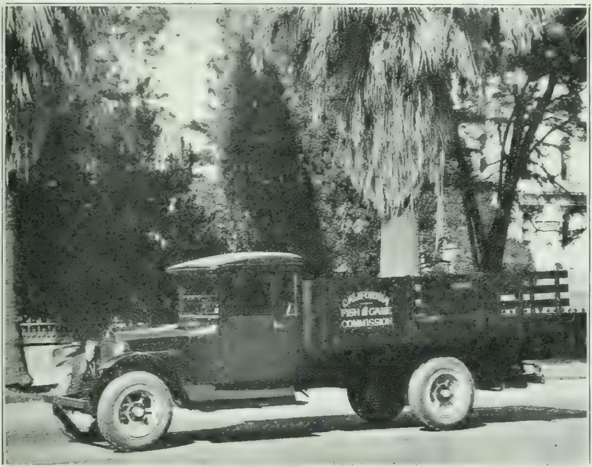


FIG. 5. Speedier transportation and better local service in fish distribution is being accomplished by the use of auto trucks, one of which is here shown.

During the biennial period we have operated sixteen hatcheries and twenty-one egg-collecting stations. Two fish distributing cars have been used to transport the fish from Mount Shasta and Mount Whitney hatcheries to the different sections of the state that are not supplied from the local hatcheries. The ever-increasing demand for fish to supply the depleted streams of California caused by the open season being entirely too long and the excessive fishing of the thousands of anglers who are fishing the streams from the opening day of the season until the season closes, has caused our hatcheries and egg-collecting stations to be operated to their fullest capacity, and yet has not produced one-half enough fish to fill the demand made on the trout waters of the state.

Before the advent of automobiles and good roads and trails, the majority of persons were satisfied with one or two trips to their favorite fishing waters. Now there are thousands who make week-end trips to places where they think they may catch a limit of fish, regardless of size. Many streams no longer contain spawners and the majority of the fish are caught out before they reach maturity or the breeding age, and the only fish found in such streams are the products of the hatcheries.

The use of salmon eggs and the eggs of other species of fishes should be prohibited as the use of fish eggs as a bait is the easiest way to catch fish. It is unsportsmanlike, as all species of trout will devour eggs of other species as well as the eggs of their own kind in preference to any other food, thus causing them to fall an easy prey to persons using eggs for bait. Nor is the use of eggs confined to the hook, but are also used to entice the fish to gather in large schools so that they can be taken with but little effort. In some places, persons, in their greed to take the fish in an unfair way, start in by using salmon or trout eggs to cause the trout to collect in large numbers. Then they take flavored canned products of the garden that are intended for human consumption and feed the trout at places where they usually gather to feed. The fish, not finding salmon eggs in quantities great enough to satisfy them, soon learn to feed on vegetable foods and are easily taken in great numbers to the detriment of those who are not so greedy but are willing to use a more sportsmanlike method in catching their fish. Such practice should be prohibited by law, particularly the use of fish eggs for bait or the use of eggs to attract the fish to congregate where they can be so easily taken.

The large output of hatcheries did not more than meet one-half the demand for fish to supply the streams and lakes and stock the thousands of barren lakes in the high Sierra. Each season new trails are being constructed and new areas opened for the pleasure of the thousands who are seeking outdoor recreation. Therefore there is increasing need of stocking all barren waters with fish and with aquatic plants and insects to improve the food supply if fish are to be furnished for those who are desirous of angling as a pleasure, and for those who desire a certain amount of food of a kind that can not be obtained anywhere else.

To meet these necessary demands on the Commission, more hatcheries must be established and lakes and streams reserved to furnish eggs for the hatcheries. But more important than these valuable sources of supply, pond systems for the rearing of brood stock must be established in several suitable locations in order to supply increased millions of eggs annually for our hatcheries. These pond systems should be built on the same general plan as that at Mount Shasta Hatchery, where nearly one-third of the fish eggs in California are produced. Ponds for the raising of the spiney-rayed game fishes also should be constructed, so that several millions of young black bass and the different species of spiney-rayed fishes can be raised annually and distributed in suitable waters as trout are distributed.

These recommendations have been made before by this department, but due to a lack of funds, these essential plans for the propagation and perpetuation of our game fishes have not been carried out.

During the summer of 1924 an intensive campaign was carried on, known as Initiative Measure Number Eleven, to prevent the erection of dams in the Klamath River or other obstructions that would interfere with the free passageway of the migratory fishes that ascend the river on their way to the spawning grounds and to the egg-collecting stations on the upper reaches of the Klamath River and tributaries. The pollution of the streams tributary to the Sacramento and San Joaquin rivers by mining debris in the pioneer days and later, destroyed the spawning beds of the salmon and steelhead trout and thus broke up their runs in many of the streams. Then followed the erection of high dams by hydro-electric power companies and the dams used for diversion and storage of water for irrigation. All this had a damaging effect on the migratory trout and salmon until approximately 90 per cent of the spawning areas in these two river systems have been cut off from the salmon or destroyed.

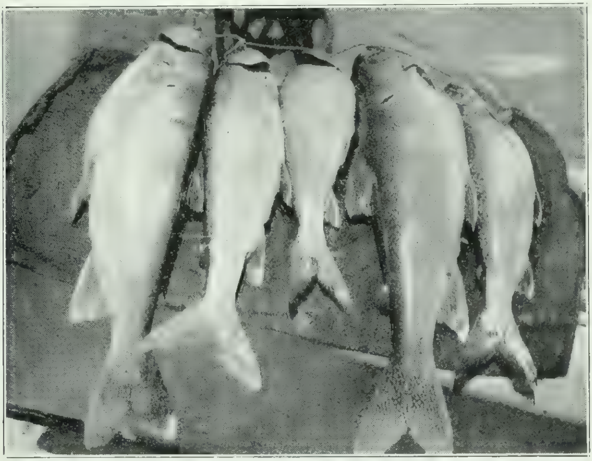


FIG. 6. Some Mackinaw trout from Lake Tahoe secured at a depth of 350 feet. During the past seasons large catches of Mackinaw trout have been made in this lake. Although originally planted in May, 1895, and taken occasionally since that time, these fish are being caught in increasing numbers in recent years.

From reliable data that we had obtained we were satisfied that it was for the best interests of the general public that the Klamath River should be set aside as a fish refuge from which a large number of salmon and trout eggs could be collected each season to furnish a supply of eggs to maintain the run of salmon in the Klamath River as well as to furnish trout eggs and salmon eggs for many of the rivers, lakes and streams in the state. This could be done without injury to the industrial development of the state. The promoters of the projects of constructing high dams for power development were actuated by a desire to promote these plans without consideration of the great loss to the state of the wonderful run of anadromous fishes in the Klamath

River. Salmon can not pass through any fishway over extremely high dams, some 250 feet in height, in numbers sufficient to maintain the run. In fact the only means of passing the fish would be a mechanical contrivance which would be impracticable and in a few years, the run would be exterminated. If a run of spawning fish were passed over the dams there remains the danger that the fry resulting from the eggs deposited in natural spawning beds or reared at the hatcheries could not be screened out of the intakes to the impulse wheels of the large power plants. The use of electric fish stops was advocated for this purpose.

We had carried on experiments with electric fish stops and had found that various models were failures, as the tingling sensation caused by the low voltage only caused the fish to accelerate their speed and pass more rapidly down the canals where the experiments were tried. Where a high voltage was used, it killed the fish. These experiments were carried out by practical tests where control of the entire experiments was under the supervision of men interested in perfecting screens to save fish from destruction in large canals as well as by the persons who held interests in the patent.

Protests were made to the Division of Water Rights and the Federal Power Commission against the granting of the rights to construct these dams, but our efforts were unsuccessful. As a last resort the Fish and Game Commission appealed to the people to support an initiative measure instituted by the Commission and sportsmen and by all those interested in saving the Klamath River run of salmon from extermination. The result was that the measure was carried by a majority of nearly 200,000 votes, thus saving the Klamath River as a fish reserve to the people. The eggs from the great run of trout and salmon may now be used to stock the Sacramento River and tributaries, Monterey Bay region and ocean areas off the shore from Fort Bragg as well as to furnish millions of trout eggs to supply other streams and lakes in this state with the wonderful trout from the Klamath region. This measure has secured for the people, a valuable asset to our natural resorces without any damage to the industrial development of the state, as there is hydro-electric power enough developed or in the process of being developed, to furnish electric power for all the needs of the state for many years to come. Other streams remain not so valuable to the fish life and these should be utilized before destroying natural resources difficult to replace.

TROUT AND SALMON DISTRIBUTION.

The following species of trout have been distributed from the hatcheries during the biennial period covered by this report.

Rainbow	26.771.373	Large Lake	2,540,820
Loch Leven	11.236.504	Cut-throat	400,000
Steelhead	5,926,900	Black-spotted	1.322,200
Eastern Brook	6.799,808	Golden	838,000
Mackinaw	75,000	Salmon	14,157,150
German Brown	3,614,000		

The excessive fishing, both in our river systems and ocean areas, has greatly reduced the number of valuable food fish that formerly entered our rivers in teeming hordes. The unusually dry fall seasons that have prevailed for a number of years past, have also prevented salmon on the upper reaches of the Sacramento River from reaching the government hatcheries on Battle and Mill creeks in their usual numbers. The obstruction caused by the dam of the Anderson-Cottonwood Irrigation District has caused the greatest destruction to the Sacramento River salmon run, as it not only prevents the salmon from reaching the spawning grounds on the Pit River and tributaries during the summer and fall, but prevents the run from passing into the McCloud River, where the United States Bureau of Fisheries could collect eggs for propagation. A small number ascends the river in the early spring before the splash boards are placed on the dam and these reach the McCloud River where a small number of eggs are collected in comparison with the number collected and hatched years ago at Baird, the oldest Chinook salmon station in the world, which has been operated by the United States Fish Commission since 1872.

Surveys have been made for an up-stream type of fishway that would easily allow the salmon that reached this dam free passageway up the river, but the directors of the irrigation district persistently refused to construct a fishway, maintaining from the start that a fishway was not necessary. This has been a matter of controversy between the Fish and Game Commission and the irrigation district directors. The Commission asked for an injunction to restrain the irrigation district from using the dam to obstruct the run of salmon in January, 1921, before Judge McDaniels who was presiding over the Shasta County superior court bench in place of the local judge who was incapacitated through illness. But owing to a conflict of testimony a court decision was not obtained. The court upheld the fishway law, but decided to make a personal investigation during the next run of salmon before giving a final decision. In the meantime, an election had been held and another judge elected to take the place of the judge who was deceased.

During 1922, the Commission commenced another action to restrain the district from using the dam until an adequate fishway was built, but a compromise was agreed upon between the Fish and Game Commission and the directors of the irrigation district, whereby a series of experiments of different type fishways were to be carried on to determine whether a passageway for the salmon could be made by removing certain sections of the splash boards, or if this failed, to construct a box-like structure to form a pool so that the salmon could pass the dam.

To this date, June 30, 1926, nothing has come of these experiments. Plans are under way to bring this matter to a final decision and we expect to have the matter settled before the salmon ascend the river this fall. In the meantime, the valuable salmon run is being reduced each season, because an adequate fishway has not been built.

The majority of the salmon eggs collected from the Klamath River have been hatched at Mount Shasta Hatchery and the resulting fingerling salmon and fry distributed in the upper reaches of the Sacramento River. But if we are to keep enough salmon in the Sacramento River and Monterey Bay region to furnish the markets with a fair supply of these fish, we must use every effort to allow all the salmon possible to ascend the Klamath River. To attain this end anything that will tend to reduce the number of spawning salmon from ascending to the upper reaches of the river must be prohibited. The use of spears, not only in the Klamath River but throughout the whole state, for the taking of any species of fishes should be stopped. Spearing fish is unsportsmanlike and in most cases is a wanton waste, as many fishes are taken, particularly salmon, that after examination, are found to be spawners and unfit for food and are thrown away and other fish caught that are fresh run and do not show evidence of having been taken from the spawning beds.

The number of salmon eggs collected from the traps at Klamathon during the last two seasons was 15,670,000, considerably less than half of the annual take of 1923.

We refer again to the recommendations made in our reports concerning the Chinook salmon in 1922-1924. "The Fish and Game Commission is waging an unhill fight when it comes to conservation, as the people do not realize the destruction of wild life until it is too late." Recommendations for the better protection of the salmon on their migrations to the spawning grounds, the prevention of the use of spears and practical and scientific methods of operating our hatcheries must be given the attention of everyone who desires to see this valuable fish preserved from extermination.

MOUNT SHASTA HATCHERY.

The efficient work and general operations of the Mount Shasta Hatchery and its auxiliary stations has continued through the present biennial period. The total number of trout hatched and distributed from this hatchery during the last two years ending June 30, 1926, was 34,818,516. The total number of salmon hatched and distributed was 6,103,000. The total number of trout eggs collected from the ponds at this hatchery during the two seasons covered by this report was 22,683,000. This number with the additional number of trout eggs shipped from outside stations makes a grand total of 38,226,000 trout eggs.

During the summer of 1925, the Commission had a deficiency appropriation made for the improvement and repairs of Mount Shasta Hatchery which had become greatly in need of repairs. The buildings were getting old and dilapidated, the pond walls needed relining, flumes were rotted and in a bad state. It was recommended that improvements should include: replacement by iron pipes; wooden tanks replaced by concrete; holding ponds relined; a new sewer system installed; the old hydro-electric plant replaced by a modern one; installation of a refrigerating plant for the manufacture of ice and for keeping the temperature at the proper degree in the cooling room where the fish food is kept; new foundations under hatcheries A and B; rustic placed on hatcheries C and D; ceiling of the walls and overhead of hatcheries C and E; installation of new hatching troughs in Hatchery E, construction of new iron fence around the grounds and a concrete walk from the hatchery grounds to the county road. Hatchery D was in such bad condition that it was decided to tear it down and construct a new and larger building on another site. These plans were all approved by the Board of Fish and Game Commissioners and after the estimates were made up, the Governor set aside $52,068.37 for these improvements, which at this date, June 30th, are being made. The Department of Public Works handled the funds as provided by law, but the work was carried on under the supervision of the Department of Fish Culture of the Fish and Game Commission. When the repairs and improvements are completed, Mount Shasta Hatchery will be one of the largest if not the largest trout hatchery in the country, and will have a sufficient capacity to care for all the salmon eggs and resulting fry that can be shipped from the Klamathon station.

During the fall of 1924, a new spawning house was built to take the place of the old building used for this purpose. The old building was in a bad state of decay and a new one was necessary. The new building is well lighted and convenient in all its arrangements, being a duplicate of the old spawning house that had been in use for twenty years. Owing to the number of persons camping and throwing rubbish, and other contaminating matter into the waters of Spring Creek before reaching the hatchery diversion, it was deemed necessary to drive an artesian well near the pumping plant that furnishes the domestic supply to the hatchery cottages and superintendent's residence. At a depth of 42 feet a flow of pure water was struck that flowed continuously 19 inches above the 2½-inch pipe that lined the well. This supply is forced into a tank and used as a domestic supply for all the buildings on the hatchery grounds.

During 1924 a new shipping can storage house was constructed 24 feet by 42 feet. It is made of corrugated iron roof and sides. A steam boiler was installed so that all the cans used at the hatchery can be sterilized by steam under pressure, thus keeping them sanitary and free from bacteria. Consequently when they leave the hatchery loaded with fish, there can be no chance of fish being affected from foul cans or of contracting disease that may cause the death of fish after planting.

It being necessary to have more room in the hatcheries at the time the salmon fry are swimming up and before they are ready to be deposited in the rearing ponds, three new ponds were built for this purpose during the fall of 1925. They are 40 feet long, 9 feet wide and 30 inches deep.

The same fall a new roof was placed on the barn, and roads on the hatchery grounds as well as the road leading to the hatchery grounds from the country road, were graveled.

The stock of brood fish in the ponds have all been in good condition during the last two years, except the eastern brook trout. Approximately 40 per cent of the eastern brook, on coming to maturity, could not be spawned as the eggs in the ovaries only partially developed. The eggs were found to be dead when the fish were opened for dissection though the females remained fat and healthy. The eggs became caked and would not slough or pass from the ovaries, but gradually shrivelled up, forming a mass of closely connected eggs that were not supplied the proper circulation to allow them to ripen. This condition has never happened before in the history of fishcultural operations in this state and we fail to find any mention of a similar condition in any of the pathological reports pertaining to the diseases of fishes. No trouble was experienced until we began to raise brood stock from commercial hatchery eggs that were purchased outside the state. We are of the opinion that this condition may be due to the fact that the majority of the eggs from commercial hatcheries are taken from very young fish and the continual breeding of these immature fish has lowered the vitality of the stock so that this condition is brought about. This condition should have a close scientific investigation, which we hope to make in the near future. In former years we had mature fish from two to six years and even older and always had perfect eggs that produced strong, healthy eggs and fish. We do not state positively that the continual breeding of young fish will produce the results mentioned above, but as soon as possible, we shall raise our own stock fish as in former years.

The predatory birds and animals have taken quite a number of brood fish during the last two years. Three otters were trapped on the hatchery grounds during the summer of 1925. A constant watch must be kept by the hatchery crew to guard against the predatory animals and birds that are constantly attracted to the ponds by the large number of fish contained in them and by the ease with which they can be caught.

FALL CREEK HATCHERY AND POND SYSTEM.

The Fall Creek Hatchery has been operated to its capacity during the period covered by this report. Improvements were made by constructing a new concrete settling tank from which a 12-inch iron pipe conveys the water to the hatchery and by installing 116 new hatching troughs. They are of a new standard size. The hatching troughs are now arranged so that each trough receives an independent supply of water. This arrangement is especially desirable at this hatchery owing to the large amount of mud and sediment carried in the water during certain periods of the year.

The number of trout hatched and distributed from this station during the biennium was 888,000. The number of salmon hatched and reared in the ponds before being distributed in the Klamath River during this period was 7,556,000. (The resulting fry taken during the fall of 1925 have not all been distributed at this date, so will not be reported on until our next biennial report.)

HORNBROOK EGG-COLLECTING STATION.

We are planning to move this station farther down the creek for several reasons:

First, the distance from the Klamath River to the trap is approximately two miles and a great many of the trout find spawning beds below the rack and do not enter the trap. As a consequence, a less number of eggs are taken than would be the case if the trap was located farther down the stream. This condition was known when we located at the present site, but we did not have money enough to construct a permanent station at that time as the formation of the creek bottom necessitated a considerable outlay of money to construct racks that would stand the floods during the spring months. With the money now available by the deficiency appropriation we can move the racks and traps and if we are fortunate in getting some assistance from some one owning teams in that section, we can move the cottage for the help, tanks, etc., on skids, to the new location. •

Second, the great number of fish that find spawning beds below the rack are a great temptation to the law violators who spear many of the spawners each season. By moving nearer the mouth, this destruction will be eliminated.

Third, the spawning season in Cottonwood Creek is later than in other streams in that region and the water is generally diverted for irrigation before our egg collecting work is over, so by moving down this stream, we have an opportunity to operate several days longer each season.

The total number of eggs collected from this station during the last two years was 2,225,000.

CAMP CREEK EGG-COLLECTING STATION.

No changes have been made at this station and none will be required for several years, as everything was put in good condition several years ago and should not require any extra expense to keep the traps in order unless damaged by floods.

The total number of eggs collected from this station in the last two seasons was 3,000,000.

BEAVER CREEK EGG-COLLECTING STATION.

Beaver Creek is one of the large tributaries of the Klamath River, entering the river about eighteen miles west of Hornbrook. Its drainage basin covers a large area and years ago it had one of the largest runs of salmon and trout of any of the tributary streams of the upper Klamath region, but like the river and all its tributaries, the excessive fishing, carried on through an altogether too long open season and the destruction of the spawners by the use of spears and other means has greatly reduced the run of fish in the Klamath as well as in all of its tributaries. There is less than 40 per cent of fish in the river than there was thirty years ago. While there is a large run in the river compared with other streams in California, there has been gradual reduction in numbers, particularly during the last few years since the road was built down the river from Hornbrook to Martin's Ferry. Before this road was built the only fish taken were by local residents. Now they are fished for by thousands of persons and if the season is not shortened, the trout in the Klamath River will soon be so greatly reduced in numbers that there will not be any better fishing than there is in other coast streams that have all been depleted.

During the spring of 1925 a trap was installed in Beaver Creek. Conditions were unfavorable, owing to extremely low water followed by flood conditions that made the operation of the traps uncertain and the results were not as good as were anticipated.

In the spring of 1926 we were more successful and a large run of trout entered the creek, but owing to the size of the creek and the great flood of water that came down at several times during the latter part of March and up to the 15th of April when the warm rains were melting the snow on the upper reaches of the creek, the flood waters could not be controlled with the temporary racks and traps. However, enough were caught and the run studied to demonstrate that there is a large run of trout that enters this creek each spring. So plans were made for a permanent trap and egg-collecting station and the work will be completed early this coming fall so as to be in a position to catch next season's run of trout. The plans for this station consist of concrete piers to support a splash-board dam with an approach to the tank trap, cottage for the help, and tanks to hold the spawning fish.

The egg take at this station during 1925 was 170,000 and during 1926, 577,000.

BOGUS CREEK EGG-COLLECTING STATION.

There have been no material improvements at this station during the last two years. When funds are available, we recommend that a concrete dam and tank trap be installed in this creek, as during periods of extreme floods in the spring months a great many fish escape up the creek that could be caught if a properly arranged trap was built.

The total number of eggs collected at this station during the last two years was 4,850,000.

SHACKLEFORD CREEK EGG-COLLECTING STATION.

In the spring of 1925, this station was opened as an experimental egg-collecting station in an effort to collect more rainbow trout eggs from the Klamath River tributaries. A rack and trap was constructed and a cabin and living quarters for help built. Shackleford Creek is subject to sudden raises as are nearly all the Klamath River tributaries. Considerable difficulty was experienced during the first season owing to high water, but a fair number of eggs was collected. The station was improved during the spring of 1926 and with the sum set aside for permanent improvements, this station will yield a good take of eggs annually.

The total number of eggs collected during the two seasons this station has been in operation was 3,000,000.

MOUNT WHITNEY HATCHERY.

Mount Whitney Hatchery has kept up its reputation of being one of the best hatcheries on the coast. While it does not compare with Mount Shasta Hatchery in regards to output and size, it turns out annually several millions of fine trout for stocking the waters of southern California as well as the region as far north as the Mono County line. In addition it furnishes golden trout for the Cottonwood Lake section and other streams and lakes in the southern high Sierra, the only place where the golden trout seem to thrive. With the ever-increasing demand for more trout to plant in the streams and lakes of the eastern slope of the Sierra where thousands of persons from southern California find their recreation grounds and enjoy the fishing in this region, this hatchery is not large enough to supply the demands made on it and as soon as funds are available Mount Whitney Hatchery should have an annex built on to it to double its capacity or another hatchery established on one of the streams in that section where the management of the Mount Whitney Hatchery could have supervision over it. All auxiliary or small hatcheries that are located in districts where the physical conditions are practically the same, that is, regarding climate, topography, stream and lake conditions, should in our judgment, be under one management. The foreman and crews should receive their orders directly from the superintendent in charge after the details of each season's work are given out by the head of the department. This system has been in vogue for the last several years at our different hatcheries and we find that we obtain better results at less expense than where there is a foreman working independently at each of the smaller stations.

We respectfully recommend that the first money available for hatchery construction after the Kaweah Hatchery is built, be set aside for enlarging the hatchery capacity for this region by either building an annex to the Mount Whitney Hatchery or by the construction of a new station on one of the near-by streams as an auxiliary to Mount Whitney Hatchery.

The output of Mount Whitney Hatchery for the biennial period ending June 30, 1926, was 7,177,000.

COTTONWOOD LAKES EGG-COLLECTING STATION.

This station is used for the purpose of collecting golden trout that are conveyed to Mount Whitney Hatchery where the resulting fry are distributed in the lakes and streams of the eastern slopes of the Sierra and in keeping up the supply of fish in the Cottonwood Lakes that are fished excessively each season. During the winter, surveys were made and negotiations entered into with persons owning the land at the mouth of Tuttle Creek with the object of establishing a golden trout hatchery near the town of Lone Pine. The citizens lent every aid possible and were very enthusiastic over the plan, but one of the persons owning land, that was of little or no value at the mouth of the creek, refused to sell or lease the site so the project had to be abandoned for the present. The plan was to collect the eggs of the golden trout from Cottonwood Lakes and convey them to the new hatchery where they could be hatched with other species and thus relieve the Mount Whitney Hatchery and increase the output of the fish to be planted on the eastern slopes of the southern Sierra.

The total number of golden trout eggs collected from Cottonwood Lakes during the last two seasons was 900,000.

RAE LAKES EGG-COLLECTING STATION.

Rae Lakes Station was operated during the season of 1924 and approximately 400,000 eggs collected. Rae Lakes is a fish and game refuge as well as all waters lying south of Fin Dome and all waters flowing into this portion of the lake and all waters flowing into these lakes lying within the sixty lake basin and all waters flowing from said lakes into the south fork of Woods Creek in Fresno County. These streams and lakes should be closed to fishing as a larger number of rainbow trout eggs can be collected if the law is strictly enforced and all fishing prohibited. When this refuge was first established, the fish were found to be in poor condition and only yielded a small number of eggs to each spawning fish owing to the lack of food in the lakes. The altitude is 10,700 feet above sea level and the land as well as the aquatic insects were very scarce. When this condition was discovered, arrangements were made by the Department of Fish Culture to introduce scuds or gammarus with the aquatic plants on which they feed. This plant of fresh water crustaceans with the aquatic plants, made during the summer of 1920, has proven to be a great success, as the scuds have increased in such numbers that the fish have an abundance of food and are increasing in size as well as producing a greater and better quality of eggs. With these improved conditions, we recommend that the lakes be posted early next season and all fishing prohibited in District No. 26, so as to allow the fish to increase in numbers great enough to furnish a good portion, if not enough eggs, to supply Mount Whitney Hatchery.

TAHOE HATCHERY.

The Tahoe Hatchery has been operated since the spring of 1921. Owing to the extremely cold water and the small amount of dissolved oxygen in the water the growth of the fry is very slow. While they remain as healthy as the average fry in hatcheries, they lack the vitality and do not develop as they do in water where there is a great amount of dissolved oxygen. A plan was made to construct a pond where the water of the springs could be collected and where aquatic plants could grow and where the water would be exposed to the warming rays of the sun and to conduct the water from the pond through an aerating system so that when it reached the hatchery the temperature would be higher and the water would contain a greater amount of oxygen. Funds were provided for these improvements and the plans are made, so that the work will be finished early this fall.

The number of fish distributed from this station in the last two years was 1,885,000.

BLACKWOOD CREEK TANK SYSTEM.

It was decided at a meeting held in Tahoe City during September, 1925, that a system of tanks was to be built on Blackwood Creek where fry could be held until late in the fall, or over winter if deemed necessary, so that they could get the benefit of the water from Blackwood Creek where the temperature was higher and the oxygen content greater, thus giving the fish a better chance to develop. Plans for these tanks have been made and the ponds set aside for the construction of these tanks and water supply. Work will be started during July and rushed to an early completion, so that several hundred thousand fry may be placed in the tanks in charge of an experienced fishculturist in order that they may receive the proper care.

TALLAC HATCHERY.

This station has been operated as in former years. Eggs were collected from the Taylor Creek, Upper Truckee River, and Blackwood Creek traps and transported to this station to be eyed and a portion of them hatched in this hatchery. The remainder were removed to the Tahoe Hatchery, as the water in the Tahoe Hatchery, after July 15th, is better suited for hatching eggs and raising the fish than at Tallac. After the middle of July the water from Taylor Creek, from which stream the hatchery receives its supply, is not suitable for hatchery purposes, but in the spring and early summer this hatchery is an important station for the purpose of eyeing the eggs collected from the auxiliary station or traps, and hatching the first eggs for local distribution. The interior of the building was overhauled and new troughs installed in the fall of 1924. The exterior and cottage should be painted and new fence built around the grounds when funds are available for this purpose.

The number of eggs collected in 1924 from Ward Creek was 550,000, from Taylor Creek, 455,000, and from Blackwood Creek, 590,000. The number collected in 1925 from Taylor Creek was 135,000, from Blackwood Creek, 590,000.

UPPER TRUCKEE RIVER EGG-COLLECTING STATION.

This station was improved and structure of the trap made permanent during the season of 1925. Permanent cribs were placed in the river and the racks and apron made of better material. A cabin for the help was built and everything arranged in good order for the work during the spring of 1926.

The run of fish in the stream is not as great as in former years, for the same condition that has caused a shortage of fish in all the tributary streams of Lake Tahoe, as well as in the lake, applies to the whole Tahoe basin. Destruction of the spawn fish over a period of many years by market fishermen and the excessive fishing of the small fish in the tributary streams before they have a chance to enter the lake and develop are the causes of shortage. More will be written on this subject later on in this report.

There was collected during the spring of 1926 approximately 500,000 eggs of the large lake trout at this station, which was a good take considering the unfavorable weather conditions that prevailed in the Tahoe basin last spring.

UKIAH HATCHERY.

In January, 1924, a new lease for the Ukiah Hatchery for a period of five years was procured from the trustees of the town of Ukiah. New troughs were installed and the hatchery put in a good state of repair to carry on the work until such time as a new hatchery can be built where there is a larger supply of water to be had. The water supply is getting less each season, due to forest fires denuding the water-shed as well as the effects of the dry seasons on all Gibson Creek and in fact all streams in the state. A new site will be selected where there will be an abundance of water and one which will be centrally located, so that the streams of Mendocino, Lake and Sonoma counties may be stocked from one hatchery and thus save the overhead expense of operating several small stations.

During the biennial period 1,181,765 trout were planted from this hatchery.

SNOW MOUNTAIN EGG-COLLECTION STATION.

This station is located below Cape Horn dam on the South Eel River and before the construction of Lake Pillsbury, furnished several millions of steelhead eggs each season. During light or even normal rainfall, the water is held back by this lake to such an extent that it seriously effects the ascent of the fish in South Eel River. During 1925 and 1926, the number of eggs collected at this station was far below the average. During the spring of 1925, we not only had a shortage of water in the main stream, but an epidemic broke out among the spawning fish and a large number of them died before reaching the trap. Likewise trouble was experienced in the holding pens. This epidemic was brought on by the low stage of the water during the season of 1924, which did not allow the spawning steelhead to return to the ocean as is their habit. Many of them were confined in large pools on the lower reaches of the river, where they remained in the warm water during the entire season. Their vitality was greatly reduced, and when they attempted to ascend to their spawning grounds on the upper reaches of the river, they were easy victims to leeches and bacterial infections. The loss was so great that we did not get more than 25 per cent of the eggs that should have been taken had it not been for these conditions.

In the spring of 1926, Lake Pillsbury did not fill up in time to allow the steelhead to ascend in their usual numbers and there was not sufficient water allowed to pass the dam to provide for the amount necessary for successful operations at Snow Mountain Station. We are hoping that the coming season will be one of copious rainfall, so that the fish can ascend the stream early and that arrangements can be made with the company to allow a sufficient flow of water to keep the fish in good order in the tanks as well as to give them free passageway through the fishway to the trap.

FORT SEWARD HATCHERY.

There has been a very successful output of fish from this hatchery and considerable repairs and replacement work done. Much of this work has been accumulating, as a shortage of funds did not allow the making of all repairs when necessary. We had to wait until the foreman and his crew could do this work between the period of hatching trout and before the salmon eggs were received. A large fir tree that had been considered safe, fell and wrecked 60 feet of the hatchery roof, a portion of the loading platform and the tram conveyor system which necessitated immediate repairs. Fortunately this occurred at a time when there were only a few thousand fish in the building and there was no loss. One hundred feet of new flume has been built and perforated zinc plate screens have been purchased, an electric alarm system installed between the foreman's cottage and the hatchery, a new overshot water wheel has been built to operate the liver and feed grinding machine and a holding pond for fry has been built in the creek, but more money must be available for the improvement of this creek pond or a new site must be selected if the fish are to be held any great length of time. Probably a series of tanks could be installed that would give better results than ponds built in the creek, particularly as the many boulders and steepness of the river makes it difficult to install the ponds and care for the fish. When funds are available, tanks such as have been built at Blackwood Creek at Lake Tahoe would give better results. The fish make such a rapid development at this station that it hardly seems necessary to recommend a holding pond system to be connected with this hatchery.

The grounds around the foreman's cottage have been improved by the construction of a new fence, a new distributing tank has been built and 90 new troughs built and placed in position. Other repairs and improvements have been made, but in addition to all this a bridge should be built between the hatchery and the railroad and a truck for the hauling of fish purchased so that the fish can be delivered by truck from the hatchery to the railroad and supplies carried to the station. The tram system should be abolished. This is very important. The foreman of Fort Seward Hatchery is to be commended for his untiring efforts to make a success of the work under these very poor conditions. When the hatchery was built, there were roads leading to Alderpoint from the hatchery as well as to the railroad. The bridges rotted and gave way and high water in the creek carried them away. Funds were not available at the time to make all these repairs, so a tramway with a skip or carrier, operated by a gasoline engine was installed which has been the only means of conveying supplies to the hatchery and the fish to the railroad. This condition has existed for the last five years. It takes over an hour to deliver 15 cans of fish to the railroad by the slow process of conveying on the tramway and then onto a car placed on rails. When going to points south of the hatchery, a hand cart is used from the end of the short car track to a platform so that the cans may be loaded onto the trains.

FIG. 7. The Grass Valley Sportsmen's Association loading trucks with fish at the railroad depot. Rapid transportation from the fish car to the stream has minimized loss in fish planting.

To overcome all these primitive and out of date arrangements for transportation, the road should be rebuilt between the hatchery and the railroad, a bridge put across the creek and a truck purchased. There should also be a bridge built across Fort Seward Creek above the hatchery to replace one washed and rotted away several years ago, so that the crew can go by earth road to Alderpoint for supplies.

An approximate estimate for these bridges and road work would be $2,000. Any good make of truck would answer the purpose for hauling. It will take at least $4,000 to put this station in such a position that the old primitive and nerve trying way of handling supplies can be discarded.

Besides the above mentioned improvements, there should be some work done on the troughs, a new feed preparing room should be built, a large ice box built, some repairs to the foreman's dwelling are needed, and an electric lighting plant installed that can be operated with gas engine. All these improvements would aggregate between $5,000 and $6,000. This hatchery is very important in keeping the streams of northern Mendocino, Humboldt and western Trinity counties stocked with fish and it is earnestly recommended that the bridge and truck be furnished as soon as possible and all the other improvements made as soon as the funds are available.

During the past biennial period this station has distributed 498,150 salmon, 3,783,620 rainbow, 1,582,700 steelhead, 108,920 large lake, 160,000 cut-throat, 200,000 black-spotted trout.

BROOKDALE HATCHERY.

All the eggs collected during the last two years from Scott Creek have been held and eyed at Brookdale Hatchery. The number of fish produced from this hatchery average in number approximately the same as in other years. In regards to this station, we make the same recommendations as were made in our last biennial report as conditions have not improved, but continue to grow worse. Quoting from our last report: "Owing to the increasing demand for water from Alba and Clear Creeks which supply the summer residents who have cottages at Brookdale and the drought which has prevailed in this section, and other causes, we deem it advisable to procure more land adjacent to or near the land already owned by the state at Scott Creek Station and construct a modern hatchery with a capacity great enough to supply trout to the counties of Santa Cruz, Monterey and Santa Clara. The land held under lease at Brookdale should be held for the use of holding ponds under the supervision of the foreman of the new Big Creek Hatchery when completed."

The total number of fry distributed from Brookdale Hatchery during the seasons of 1924 and 1925 was 1,445,000.

SCOTT CREEK EGG-COLLECTING STATION.

The number of spawn fish at this station has fallen off considerably during the season of the spring of 1926. In 1925, approximately 3,000,000 eggs were collected from Scott Creek which is the annual average take of eggs at this station. During the winter of 1925, repairs and improvements were made at this station. The conditions of the stream were favorable for an average take of eggs in the spring of 1926, but only 1,300,000 were collected. In the opinion of our foreman at Brookdale as well as others, the numbers of fish are being greatly depleted by the loss of small fish at the pumping plants located on this creek, which in our opinion should not have been allowed to be installed as the creek was set aside by an act of the legislature as a fish refuge. Consequently we do not believe anyone had a right to appropriate the water for other purposes. There has been no effort made to prevent fishing in the creek. Poachers have worked on the stream, both in and out of season and the deadly and destructive spear has been used. We are planning to have a watchman employed by the year to patrol the creek and protect the fish at all times and enforce the law against fishing in Scott Creek. It is hoped that by doing this and by stocking the stream heavily and having the pumping plants properly screened, to restore this creek to its former condition.

CLEAR CREEK HATCHERY.

This station has been operated to its capacity during the last two seasons. The usual repairs have been made. The total number of rainbow trout eggs collected at this station during the biennial period was 3,000,000. The number of fish distributed was 1,359,462.

WARNER CREEK TRAP.

This trap was operated as usual and the eggs taken were sent to Domingo Springs where they were eyed and part of them shipped to other stations, the remainder being hatched and distributed from the Domingo Springs Hatchery.

DOMINGO SPRINGS HATCHERY.

This station has been operated during the last biennial period as in former years, except that the number of spawning fish are getting less owing to the same conditions that are affecting all the streams tributary to Lake Almanor, and that is excessive fishing. To improve conditions at Clear Creek, Domingo Springs and Warner Creek egg-taking stations and hatcheries, we recommend that a large hatchery with a capacity of not less than 3,000,000 fish be established on one of the tributaries of Lake Almanor and that all the eggs collected from Clear Creek, Warner Creek, Rice Creek, and Butt Creek be hatched in one centrally located hatchery where the fish will thrive better and can be better cared for with less expense than where so many small stations situated so near each other are operated.

The Red River Lumber Company has offered the state a site for a large hatchery on the northwest shore of the lake where an abundant supply of water from the North Fork of the Feather River is available for hatchery purposes and for a pond system. A stock of brood fish to furnish eggs for the hatchery when the number of spawn fish in Lake Almanor is reduced is desirable to keep this lake supplied with an adequate number of fish to furnish fishing for the many anglers who frequent this lake each season. Lake Almanor can be kept well supplied with trout if adequate plans for keeping it stocked are taken in time.

This station planted 1,844,722 fish in the last two seasons.

BUTT CREEK EGG-COLLECTING STATION.

Racks and traps were built across Butt Creek in the spring of 1926 near its junction to the outlet of the Lake Almanor tunnel about two miles from Butt Valley Reservoir, but owing to a heavy flood during April, the racks were so badly damaged that the fish escaped and no eggs were collected. A cabin was also constructed for the help. It is planned to improve the racks another season by building a crib in the stream and by using heavier timbers.

PINE CREEK EGG-COLLECTING STATION.

An attempt was made to collect eggs of the large rainbow trout that ascend Pine Creek from Eagle Lake, but it was found that owing to the light fall of snow that melted so rapidly, that the stream did not keep up long enough for the crew to determine whether or not the run of fish in this creek will justify further expense in an attempt to collect eggs.

FEATHER RIVER HATCHERY.

After carrying on experimental work at this station in 40 troughs under a tent, conditions were found favorable for establishing a permanent hatchery at this place. A lease for a period of 25 years was procured from W. A. Adams. Plans were made and during the fall of 1924 a hatchery containing 60 troughs was constructed and a cottage for the help and a dwelling for the foreman built. This station is located 4 miles from Clio on the Western Pacific Railroad and is only a short distance from the Gold Lake region where there is a number of fine mountain lakes that require stocking each season as well as the streams tributary to the Middle Fork of the Feather River, streams in Sierra Valley and surrounding country and the region along the North Fork of the Yuba River.

The hatchery has turned out a fine lot of fish. The only improvements of any consequence at this station will be the laying of a two-inch pipe line this fall from the settling tank to Mr. Adams' residence as the water from the hatchery flows into the domestic supply and a supply of pure water must be furnished Mr. Adams' residence.

From this hatchery 2,086,100 fish were planted during the biennial period.

BEAR LAKE HATCHERY.

During 1925, operations were started during March by installing the traps in the creeks tributary to Bear Lake. At the opening of the season conditions did not appear to be favorable for a large take of eggs, but as the season advanced, conditions improved and Bear Lake furnished its usual supply of eggs. Of the 5,700,000 eggs collected, 2,700,000 of these were shipped to other streams, 2,000,000 hatched at Bear Lake Hatchery and 1,000,000 at North Creek Hatchery. Reports have been circulated for many years by the resort owners and others that Bear Lake rainbow trout were being exterminated. These figures show conclusively that the system under which we are working at Bear Lake can not be improved. The lake is one of the best examples of fishcultural success in this state or any other state, when the excessive fishing of thousands from Los Angeles and other parts is taken into consideration and the fact that there are thousands of predatory bass in the lake and that all the tributary streams dry up before the middle of July and that all the trout in Bear Lake are the result of artificial propagation and distribution.

The fish are held in the hatchery until the lowering temperature and cold weather drives the large trout and bass into the deeper parts of the lake, then the small fish from the hatchery are distributed in the shallows along the shores where they have an abundance of food. By the following spring, these young fish work into the deep water at a time when the bass and large trout are coming toward the shores to find breeding places. This system has been kept up for the last six or eight years and the results can not be equalled or surpassed by any system in the country.

Improvements were made during the season of 1925 by moving the cabin, remodeling and relining it and painting it on the interior and exterior surfaces. The troughs, baskets and other paraphernalia were overhauled and painted, wood cut for the coming season and the truck overhauled during the winter.

During 1926, egg-collecting operations were begun in March. At the time this work was started there was no water flowing in any of the creeks, but there was about two feet of snow on the ground. The traps had to be dug out of the snow. Four traps were operated as soon as the melting snow started the streams flowing. A heavy rain storm in April washed the traps out, liberating a great many of the fish. The traps were replaced and there were collected and eyed ready for hatching 4,555,000 rainbow trout eggs. There was a loss of approximately 1,000,000 on account of the heavy storm during April. The embryos at the time of the storm were in a tender or delicate stage and were covered with deposits of sand and mud and in the efforts to prevent the eggs from smothering a loss of approximately 1,000,000 eggs took place. These eggs were eyed in the North Creek Hatchery where the main trap and egg-collecting station is located.

There is quite an agitation by persons not familiar with conditions at Bear Lake, to hold the fish over winter in ponds constructed by fencing off a portion of the lake, as well as in concrete ponds to be built to hold the fish. These plans will not improve fishing in Bear Lake as the present plan under which we are operating has produced remarkable results and it is based on twelve years of experience in keeping this lake stocked under the most adverse circumstances. The reports of our crews who have given this lake careful study verify all the above statements and the writer has been familiar with Bear Lake for over 35 years. The writer planted the first fish introduced into this lake when, as an apprentice fishculturist, he made his first trips planting fish. The fish were carried on mule back over the old trail up the Santa Ana River and planted in Bear Lake.

NORTH CREEK HATCHERY AND EGG-COLLECTING STATION.

All the eggs hatched in Bear Lake Hatchery at Green Spot Springs as well as those hatched in this small hatchery, were eyed and prepared for shipping and hatching in this station. In 1926, 900,000 eggs were hatched in North Creek Hatchery and the resulting fish were planted in the streams of San Bernardino County, together with 100,000 fish that were taken from Bear Lake Hatchery.

GROUT CREEK TRAP AND STATION.

The trap in Grout Creek was operated during the last two seasons with fair results. Large numbers of fish enter this creek, but owing to the great deposit of sand on the flats near its mouth, the stream spreads over such a wide distance during the period when warm rains are melting the snow that it is very difficult to catch the fish. The stream at times reaches a width of a hundred yards and is very shallow. There is no way, except at heavy expense to trap this creek successfully when the floods are on, and that is the time when the majority of the fish are ascending the stream. The traps have been moved and washed out several times during the last few years.

Considerable trouble was had during the last two seasons in operating traps on this creek. The stream generally dries up by the middle of June and does not start flowing until the following spring. We installed a permanent trap some years ago about one-half mile from the mouth, but the majority of the fish would find spawning beds in the sand below the trap. During an extremely heavy flood a few years ago, the permanent trap was wrecked. Since then, temporary traps and racks have been used. A number of plans have been made to successfully catch the fish in this creek and thus save their eggs, but the best the crews have been able to do was to place a rack in the most favorable place in the old channel and as soon as the spring rains began to melt the snow and the creek reached the flood stage, and to drive the fish back and pick them up wherever possible with dip nets. The hatchery crew, assisted by the game wardens, put in several strenuous days during the spring of 1926 in catching up and saving hundreds of trout that would have perished when the water receded. Thus a large number of eggs were collected that otherwise would have been wasted.

Fig. 8. Wawona Hatchery, output of which is used in stocking lakes and streams to the southward of Yosemite Valley. Photograph by G. C. Tabler.

METCALF, PAPOOSE, KIDD, NORTH AND KEYSTONE CREEKS.

These creeks are all tributary to Bear Lake and all except Metcalf Creek dry up except for a few inches of water that flows in North Creek and Kidd Creek during the summer months. They are all short streams and flow during the spring months when the spring rains are melting the snow or during the rainy spells in the spring months. There is a deposit of granitic sand at the mouths of all these streams and it is very difficult to operate the traps as the fluctuating level of the lake changes the mouths of these creeks. For the last two seasons the surface of the lake has been approximately twenty feet below the crest of the dam. When a condition such as this exists, it is very difficult to keep the mouths of the streams open for the passage of the fish to the traps. Despite all these difficulies we have maintained a large number of trout in this lake by following the plan of planting the fish in the manner described above. A great many more details could be written on this subject but space in this report is not available.

WAWONA HATCHERY.

This station located on Big Creek near Wawona, Mariposa County, has been in operation for the past thirty years. It has supplied fish for the South Fork of the Merced River as well as for a number of lakes and streams on the south and east of the Yosemite Valley. The total number distributed from this station during the last two years was 337,500 rainbow and 439,300 steelhead.

KAWEAH HATCHERY.

This hatchery has been operated under a tent since it was established in 1919. A permanent building should be erected as soon as funds are available. During the last season when funds were being set aside for the construction of a permanent building and repairs and improvements to the hatcheries, ponds, etc., we carried on an experiment at the new site on the Kaweah River to determine whether or not the water was suitable for hatchery purposes. The old site at Power House No. 1 of the Mount Whitney Light and Power Company on the main highway leading to Sequoia National Park, proved by years of hatching to have an excellent supply of water, but a number of persons connected with the different sportsmen's organizations in Tulare County were of the opinion that a site at Power House No. 3 would be of easier access when shipping fish as well as being more convenient to the tourist travel. The troughs were moved to a temporary hatchery under a plain frame, covered with paper roofing. We were doubtful whether this site would prove suitable as the water is taken

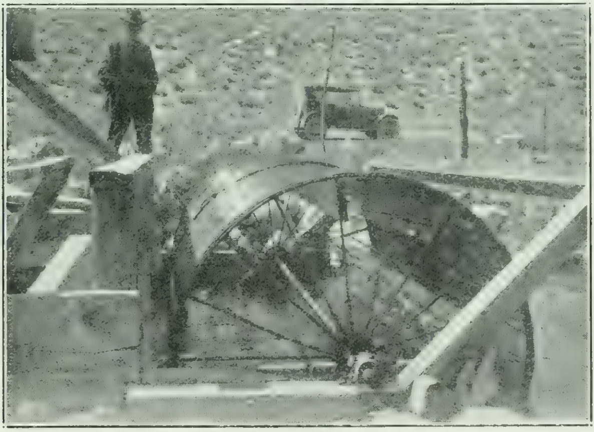


FIG. 9. Fish screen erected by the Cain Irrigation Company at Grant Lake, Mono County. Photograph by A. E. Culver.

from the Middle Fork of the Kaweah River which has a higher temperature and contains a greater amount of organic matter. The water supply at the old site at Power House No. 1 is taken from the East Fork of Kaweah River and the writer made an examination of the water at this site and found it suitable for hatchery purposes before any attempt was made to establish even a temporary hatchery. The change from the old site to the new site is proving that the water at the new site is not suited for hatchery purposes. No doubt during the fall it will be necessary to move back to the old site and operate there under a tent until more funds are available for the construction of a permanent hatchery which is badly needed in that section.

The output of this hatchery duing the last two seasons was 435,000. In 1924 we distributed 340,000 and in 1925, 95,000 were planted. The small number planted in 1925 was due to the fact that the water supply was accidentally shut off by a shear board getting loose in the intake box and closing the pipe that furnished the water to the hatchery. The fish perished before the foreman in charge was aware of what had happened. There is an electric alarm system connected with the water supply at all the small hatcheries so that if the water is shut off or the flow is diminished, the alarm bell will ring, thus awakening the help, but on the night that the board closed the intake to the supply pipe, the alarm, for some reason unexplained, failed to work and when an hour or so after the accident, the foreman entered the hatchery nearly all the fish were dead. In 1926 while we were experimenting at the new site an extra man was kept so that during times there was danger of the supply of water fluctuating or of algae floating in the water and causing the screens to choke, some one was always on duty.

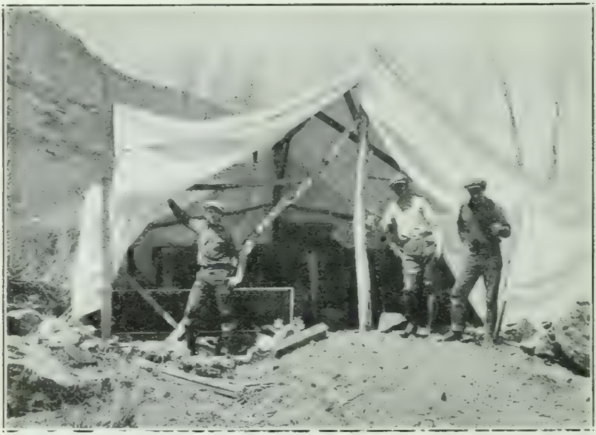


FIG. 10. Experimental hatchery on Rush Creek, Mono County, June 1, 1925. This temporary hatchery is to be replaced soon by a modern hatchery devoted to the rearing of black-spotted trout.

RUSH CREEK EGG-COLLECTING STATION.

During the spring of 1925, it was decided to establish an egg-collecting station on Rush Creek, Mono County, to collect the eggs of the black-spotted trout. A trap was placed in Rush Creek, a holding tank was built and a temporary hatchery installed under a tent on Silver Creek. Two traps were installed in Reverse Creek, one in Upper Reverse Creek and the other in Lower Reverse Creek in addition to the main trap in Rush Creek.

The take of black-spotted trout eggs from this operation was very gratifying. The black-spotted trout of this region have an excellent lot of eggs that produce vigorous embryos and develop into strong healthy fish. The take of eggs of black-spotted trout from Rush Creek and tributaries during 1925 was 1,010,000. We were fortunate in procuring an egg-collecting station where eggs from this species can be collected as this excellent fish will thrive in all the lakes in this region. Black-spotted trout to the number of 727,500 were planted from this station. The balance of the eggs were shipped to Mount Whitney Hatchery.

JUNE LAKE.

During the spring of 1926, arrangements were made to seine June Lake for steelhead trout. June Lake was first stocked with steelhead trout in 1921. Fishing did not begin for these fish until the season of 1923. During the entire season of 1924 this lake was fished continuously. Many large steelhead weighing from five to eight pounds were taken. In 1925 the fishing improved as the anglers were taking fish in limit catches. The anglers began catching the fish planted in 1922 and 1923 and caught three sizes of fish (being the result of three years' planting since the 1921 plant) ranging from one-quarter pound to twelve pounds in weight. It was a common sight to see twenty to thirty boats on June Lake during the fishing season and all parties catching fish. The native trout of the lake were the black-spotted trout that would ascend Rush Creek during seasons of very heavy rains and snows. These fish would come up from Grant Lake during the spring when an extra heavy rain and snowfall would fill June Lake so that the water would run from June Lake to Grant Lake. No water has flowed from June Lake to Grant Lake in the last six years owing to the unusual dry seasons that have prevailed in that region as well as throughout the entire state, which has materially affected the fishing in all the lakes and streams in California.

As there are no tributary streams to June Lake, the supply of water being kept up by the melting snow and by rainfall, the steelhead trout have no place to spawn, so it is necessary to stock this lake each season and to catch the spawners with a seine when they approach the shores trying to find a place to deposit their eggs. During the short period that our crews were operating on the lake before the opening of the trout season, 1,000,000 eggs were collected. The crews were only operating about ten days when the season opened, May 1st, and the rush of anglers to this lake drove the fish from the shallow water near the shore and compelled our men to cease their operations. The season on the lake as well as throughout the entire Sierra region should not open until June first. Thousands of spawning fish are taken each season from the spawning beds or on their way to the spawning grounds by anglers during the month of May. This should be prohibited.

FERN CREEK HATCHERY.

Owing to the successful operation on Rush Creek and June Lake in egg-collecting work and the demand for a hatchery in this section, plans were made to have a permanent hatchery established, centrally located, to supply fish to this now famous fishing region where thousands of persons from southern California and other places spend their vacations. An adequate sum was set aside by the Commission to carry out these plans. Material was ordered during June and the work of constructing the hatchery will be started as soon as it is delivered on the ground.

BURNEY CREEK HATCHERY.

The power development on the Pit River including the construction of high dams and the diversion of the water by the Pacific Gas and Electric Company, has broken up the run of salmon that annually ascended this river to spawn and has prevented the trout from making their seasonal migrations in the Pit River. The company agreed to establish hatcheries to take care of this situation as soon as the Department of Fish Culture should decide on the proper location. During the fall of 1925, surveys for hatchery locations were made and a site for a permanent trout hatchery was selected on Burney Creek on land owned by the company, just below Burney Creek Falls. This is a very desirable site, as the land adjoins the Burney Creek State Park. The location is about one-half mile from the shore of Lake Britton which is formed by the dam constructed for the purpose of raising the water level in Pit River to give it the necessary elevation to operate Power House No. 3 of the Pacific Gas and Electric Company's hydro-electric plant. Plans were immediately made by the Department of Fish Culture which met with the approval of the company and the work of establishing this new station will be started this summer and completed by early fall. The Burney Creek Hatchery will enable the Commission to keep the streams of Pit River basin stocked and the lakes and streams as far north as Modoc County, as well as other parts of Shasta County.

HAGAN FLAT SALMON HATCHERY.

A site for a set of racks and salmon traps was selected at Hagan Flat, Shasta County, for the purpose of collecting salmon eggs and hatching and rearing them, to assist in keeping up the rapidly decreasing supply of salmon. But owing to the uncertainty of the run reaching this far up the river because of the obstruction caused by the dam of the Anderson-Cottonwood Irrigation District at Redding and the diminished run of salmon in the Sacramento River it was decided not to build the salmon station at Hagan Flat until the fishway problem at Redding was settled. Also there is a possibility that it will not become necessary to build a hatchery at this place if the company, in carrying out their projects, will build a road to this reach of the river. All that will then be necessary is the placing of the racks and traps in the river to catch the salmon and convey the eggs by truck to the Burney Creek Station, where the eggs can be hatched and the resulting fish transported to a point below the last dam or diversion in the Pit River. There are other hydro-electric projects contemplated below Hagan Flat by other interests, that will have to be considered this coming season. If the obstruction at Redding is removed plans should be made without any further delay to establish a salmon hatchery on the Pit River. Early next season this matter should receive attention and action taken to the end that whatever salmon ascend the river can be manipulated for their eggs. Every salmon possible should be hatched and distributed in the Sacramento and tributaries as there is less than 10 per cent of the former breeding grounds of the salmon left. Salmon are decreasing so rapidly that if enough salmon are to remain in our waters to supply the local markets during a portion of the year, the chinook salmon must be propagated to the fullest extent.

BIOLOGICAL WORK.

Under the supervision of Geo. A. Coleman, biological investigations concerning our fresh water food and game fishes have been carried on at Lake Tahoe, Clear Lake, Eel River Basin, Merced River Basin, Lake Elsinore and other places where scientific problems had to be worked out to improve conditions of fish life. Plankton surveys have been made looking toward the introduction of different species of fishes into barren lakes and the improvement of fish-planting work.

This is a very important feature of the work of the Department of Fish Culture and should be continued for a period of years until practical biological surveys of all the inland waters are complete, so that an intelligent distribution of fish can be made. While the department has valuable data on many streams and lakes, there are miles of streams and hundreds of lakes that should be given scientific investigation. New problems are coming up that require special field investigation. The long period of drought has changed the physical conditions of many of our streams to such an extent that it is necessary to have special investigations made to determine whether new species of fishes should be introduced to meet the changed conditions. The denuding of forests, the construction of large reservoirs, breaking up the run of our native species, the holding of the water in large reservoirs causing the temperature to be higher than when the streams flowed unobstructed, and many other conditions brought about by the use of water for the development of the industries of the state have made it necessary that a biologist connected with the Department of Fish Culture be employed to solve the problems that are continually arising.

GENERAL CONDITIONS AND RECOMMENDATIONS.

Open Season. Owing to the excessive fishing in all the lakes and streams of California, it is necessary to find a new source of egg supply to add to the rapidly diminishing supply of adult trout or spawners. Several pond rearing systems for the raising of brood stock from which eggs can be collected should be built as soon as funds are available. The construction and maintenance of large rearing ponds is absolutely necessary to furnish an adequate supply of eggs for the hatcheries.

In particular, the supply of rainbow and steelhead trout eggs is rapidly diminishing, for the adult fish in all the lakes and streams are getting less each year.

The trout in Lake Tahoe suffered a heavy loss from an epidemic of unknown cause several years ago. The fish planted in the tributary streams of Lake Tahoe are caught before reaching the lake and do not have a chance to develop. We earnestly recommend the passage of a law prohibiting fishing in any of the streams tributary to Lake Tahoe, so that the fish planted in the streams may have a chance to remain in the streams until they can reach the lake and there make a growth that will be of some value to anglers. A shorter fishing season must be had if fishing of any consequence is to be maintained in the lakes and streams of California.

The open season for trout should be so regulated as to give the spawning fish every opportunity to deposit their eggs before being caught, and at the same time allow the egg-collectiong stations an opportunity to collect all the eggs possible before the fishing season opens. The season should not be open before June 1st anywhere in the Sierra region. The coastal region should open May 1st and close October 1st. The coastal district should include Mendocino and San Diego counties. In District No. 1½, the season for trout should open June 1st and close November 15th. The use of spears in all districts and the use of fish eggs of any species for bait should be prohibited.

Lake Tahoe. Referring to the conditions at Lake Tahoe, we can not too strongly urge further biological studies regarding the fish in this lake. The excessive fishing for over forty years by the market fishermen before the law prohibiting the sale of trout was passed, the impounding of the water in Fallen Leaf Lake, the diversion of water from the tributary creeks for domestic purposes, the loss of fish several years ago by an epidemic during the winter and early spring have all been contributing to a general depletion of the trout in Lake Tahoe. For reasons that we can not account for the white fish that formerly abounded in the lake by the thousands, have been gradually becoming less and they have not been caught by anglers and fishermen. Years ago, during the breeding season in the fall, these fish would approach the shores in schools of thousands and ascend the Upper Truckee River where they deposited their eggs. There has been a great falling off in the number of fish of these species, for reasons as above mentioned, that are unaccountable. While there has been a fair run of fish in the creeks during the spring months, not many have been caught in the lake during the summer months. The hatcheries have planted an average of 2,000,000 fish each season, but we have not obtained the results that we do in other lakes and streams. A close study of conditions must be made to determine the cause of the apparent shortage of the native species.

The Mackinaw trout were introduced into Lake Tahoe in 1895 at the request of the market fishermen and others, so the writer was informed at the time the eggs were shipped to California. The Nevada State Fish and Game Commission also hatched and planted Mackinaw trout in Lake Tahoe at approximately the same time. The exact date that the Nevada Commission introduced the fish into Lake Tahoe is not known. Some persons claim the Mackinaw trout were introduced first by the Nevada Commission. As near as the writer can determine the Nevada and California commissions introduced them at about the same time. Some of these fish were introduced into Fallen Leaf Lake where they found suitable breeding grounds as the young of the Mackinaw trout were caught frequently. Very few were taken from Lake Tahoe. Occasionally a Mackinaw trout would be caught, but they were so rare for many years after their introduction, that the writer was of the opinion that they could not find suitable grounds on which to spawn and that the few that were taken, descended from Fallen Leaf Lake to Lake Tahoe. Mackinaw trout do not asend the streams to spawn, but deposit their eggs on reefs in water from 4 to 6 or 8 feet in depth. As such places are unknown in Lake Tahoe, it was supposed that the Mackinaw trout would never be taken in any numbers, but during the last seven years, 24 years after their introduction into the lake, they are appearing in ever-increasing numbers. This summer they were being caught at many different places in the lake. They have evidently found suitable breeding grounds and are increasing rapidly. The Mackinaw trout is one of the large charrs, native of the lakes of northeast America. The type introduced into Lake Tahoe are natives of Lakes Superior and Michigan. They are a good food fish and afford sport for those who enjoy trolling for fish in deep water. Occasionally they reach a weight of from 50 to 60 pounds, but the average weight of the adults is about 20 pounds. As they are piscivorous in their habits, devouring a large number of other fish, they will have an abundance of food in Lake Tahoe because of the countless millions of minnows and chubs. As they inhabit deep water during the greater portion of the year, they may not devour as many of the native species of trout as is generally supposed, but a biological survey and a study of their habits will be carried out this coming summer to determine what proportion of their food is composed of the native species of trout and what proportion is minnows and chubs.

Hat Creek and Fall River. Considerable comment has been made regarding the conditions on Hat Creek and Fall River and the absence of screens in the canals leading to the power houses operating on these streams. This department has always contended that the trout in Fall River and Hat Creek were nonmigratory and that they do not descend these canals and pass through the impulse wheels of the power plants and thus get destroyed as is claimed by others. The nature or physical condition of these streams, in our judgment, has changed the habits of the trout to such an extent that they do not migrate from one portion of the stream to another or pass out of the streams into Pit River. The water in these streams comes from large springs that furnish the entire flow of Fall River. A greater portion of the water in Hat Creek above the Power Company's canals comes from Rising River, a short river that rises from a large spring in the lava. Rising River is only two miles in length from its source in one of the largest springs on the coast to where it unites with Hat Creek, a stream that rises on the north basal slopes of Mount Lassen. The fish in Hat Creek above the confluence of the two streams, do not descend the stream to where the main streams flow into the junction, nor do the fish in Rising River ever leave the main stream, except the emaciated and dying spawn fish that die each year after their efforts to propagate their species. Then the weakened and dying fish drop down the stream where they are found on the grizzlies at the head of the canal. The same condition exists in Fall River. The reason, in the opinion of the writer, for the nonmigratory habits of the fish in these two streams, is that the temperature varies only slightly in comparison with the Pit River and other streams in this region and the flow is constant. There is but a very small difference between the maximum and minimum flow in each of these streams. The water is not affected by the flood conditions as the streams are short, receiving their supply from the large springs which have a constant head throughout the year. The aquatic insects and crustaceans on which the fish feed are abundant, the water is nearly all clear, seldom, if ever, getting riley. All these and many other physical conditions relating to the stream beds, velocity of the water, etc., all have a tendency to cause these fish to acquire habits that make them nonmigratory. The writer has studied the conditions in these streams and the habits of these fish for many years and is satisfied that his judgment is correct. But to make an absolute test to either prove or disprove that the writer has not made an error regarding the habits of the trout in these two streams a rack-screen will be installed below Power House No. 1 of the Pacific Gas and Electric Company. For this experiment, the Commission is working in conjunction with the power company. The cooperation of the Bureau of Fisheries has also been obtained and the foreman of the Baird Hatchery has been instructed to assist in the investigation. Members of the sportsmen's associations will be requested to assist in checking up on this experiment to determine beyond any question of a doubt whether there is any loss caused by the trout passing through power wheels, and if so, to what extent.

This experiment will be carefully checked by the biologist of this department, Mr. Geo. A. Coleman, so that if any fish are found on the rack-screen, the cause of death can be determined. If only emaciated and dying spawners show up, which can be easily determined by dissection and study of the anatomy of the fishes, it will be unnecessary to screen the canals leading to the power houses that receive their water from Hat Creek and Fall River. But on the other hand if healthy fish in normal condition are found on the racks, it will be necessary to have proper screens installed at the intakes to the canals leading from these two streams. It is planned to keep the rack-screen in place for a period of approximately one year so that every condition of seasonal change that might possibly cause the fish to descend into the canals can be observed and data gathered.

Spiny Rayed Fishes. Owing to the great demand on our trout streams, we deem it advisable to establish pond rearing systems for the propagation of such food and game fishes that will thrive in the warmer waters of the state. Properly constructed ponds and nurseries for this purpose will be built and the rearing of these fishes placed in the hands of experienced pond culturists. Several millions of the spiny-rayed fishes can be raised each season and distributed in suitable waters the same as trout are distributed. This would add greatly to the fishing attractions of the state and relieve the rush of anglers to our trout lakes and streams.

Holding Ponds and Rest Stations. Owing to the demand of a number of sportsmen's associations, for the raising of trout to a larger size before being distributed, arrangements are being made where these associations may construct ponds and hold the fish until late in the fall before making the distribution. This experiment will be carefully watched and a check made to determine whether the system is practicable and whether better results are obtained than the system of planting No. 1, 2 and 3 fingerlings directly from the hatcheries.

Several of the sportsmen's clubs have established rest stations or small holding ponds in the mountainous parts of the state where the fish are delivered from the distribution cars and held for several days to enable them to recuperate from their trip from the hatcheries. They are then taken by pack animals and other conveyances to the more inaccessible lakes and streams. This system has been carried on with good success, particularly by the Fresno County Sportsman's Club who have placed the work of distributing the fish in the hands of experienced planters. Other associations as well as some of the boards of supervisors are planning to adopt this system of resting the fish before carrying them to the waters in the higher elevations not accessible to the trucks.

In conclusion, the demands on this department of the Commission as well as on all other departments, makes it necessary that we have a great deal more money than is now available and it is up to the sportsmen if they desire to maintain good fishing in the lakes and streams of the state, to increase the licenses and to protect the spawning fish by a later opening season and a shorter one in most districts.

REPORT OF THE DEPARTMENT OF COMMERCIAL FISHERIES.

By N. B. Scofield, In Charge.

Since making our last biennial report there have been a number of changes in the Department of Commercial Fisheries. In July, 1924, it became necessary to employ an attorney for the impending litigation with a few canners and reduction plants in their attempt to have the fish reduction act declared unconstituional. B. D. Marx Greene was employed as special counsel for the department, where he remained until January, 1926, when he was appointed to the position of executive officer of the Commission.

I can not praise Mr. Greene too highly for his quick grasp of the highly technical details of the sardine canning and reduction industries and his knowledge of the rather special field of fish and game litigation. Added to this was his excellent handling of all the cases in the courts. One of these, in the State Supreme Court (*State of California* vs. *The Monterey Fish Products Company*) resulted in a decision by that court which is nation wide in its importance.

After Mr. Greene's appointment as executive officer, the Commission was reorganized. This reorganization was of considerable importance to the department of commercial fisheries, in that it brought about a more business-like arrangement whereby the departments reported through the executive officer instead of to each separate commissioner according to which part of the state was in question. This did away with one policy in the enforcement of laws in one part of the state and a different policy in another part of the state.

A department of patrol was formed which took over the commercial fisheries patrol in San Francisco and on San Francisco Bay which had been in charge of the department of commercial fisheries. The Department of Commercial Fisheries kept the commercial patrol which operates out of the department's offices at Monterey, San Pedro and San Diego. The department also gave up its work on bay and harbor pollution which was taken over by the new Bureau of Bay and Harbor Pollution.

Captain H. B. Nidever is in charge of the commercial patrol for southern California with headquarters at our San Pedro office. Mr. Nidever is especially well qualified for this position. He has been with the Commission on fisheries work for eighteen years, and has been with this department since its organization.

Our last biennial report told of the rapid growth of the sardine fishery in this state during the time of the war, reaching its peak in 1919; and of the slump and decline of the fishery in 1920 and 1921, due in large measure to marketing conditions in foreign countries; how the lowest ebb was reached in 1921 and then the rapid rise until in 1923 the sardine catch was equal to that of the banner year of 1919 and the state's fisheries as a whole were likely in a short time to equal the mark reached through the stimulus of the war. This prediction has been fulfilled and during the past two years the total production of the fisheries, during either of the years, has exceeded that of any year in the history of the state. The total catch of all fish for the year 1924 was 327,645,017 pounds and in 1925 it was 414,753.312 pounds. The fluctuation in total catch for the past several years has been caused by the fluctuation in the sardine catch. The total catch of fish, other than sardines, remains fairly constant. This is well illustrated in figure No. 11. The total catch of all species of fish together with the amount of the fish pack and of all fishery products is given in the appendix to this report. We are quite sure that California's fisheries for both volume and value of the products exceed that of any state by a good margin.

SARDINES.

The sardine fishery is now the most important of our fisheries industries. It is the most variable in quantity of fish caught and it presents more complicated problems to the state's administration than any other. The large profits to be made on fish meal and oil from sardines, together with the state's policy of confining the use of sardines to the production of human food, has caused most of the trouble. Each cannery had its own by-products plant and the more sardines they turned into fertilizer and oil the greater their profits. The law prohibited the use of food fish for reduction purposes, but provided that sardine canners could use up to 25 per cent of the catch in their by-products plants, the percentage to be allowed each season to be determined at hearings held before the Fish and Game Commission. It was found that this law was very difficult to enforce, for there were too many ways in which its provisions could be avoided. We therefore recommended in our last report that this law be redrawn and that the hearings before the Fish and Game Commission be eliminiated and the amount of sardines which it is legitimate to use in the by-products plant be definitely fixed in the law. It was also recommended that the penalty for violation be quick and severe.

In the fall of 1924, before this law could be amended by the legislature, the Monterey Fish Products Company, an independent reduction plant, attacked its constitutionality on the ground that it permitted a canner to use sardines in a reduction plant but did not permit a reduction plant not operated by a canner to receive sardines direct from fishermen, and was therefore discriminatory. This case went to the State Supreme Court where it was decided that the law was constitutional. This decision was not rendered until March, 1925. In the meantime the canners and the Fish and Game Commission had agreed that the law should be amended and with that object in view one or two conferences were held and it was agreed with the canners that the law should be amended so as to do away with the hearings before the Commission and to put teeth in the law so that a violator could be stopped at once. The amount of overage was to be 25 per cent based in some way on the capacity of the cannery. The Commission's attorney was to draw up the bill and submit it to a future conference or to representatives of the canners and the canners were to stand with the Commission against those who would exploit the state's supply of sardines for the making of fertilizer and oil. Two other factions were asking that the law provide for them. One was a company which wished to use a reduction process to produce fish flour for human consumption.

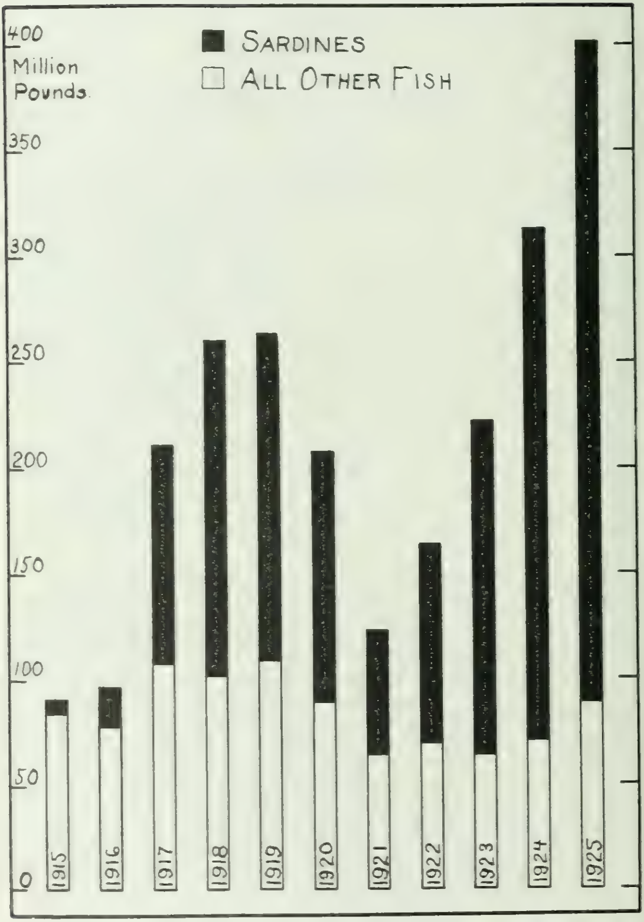


FIG. 11. Graph showing the catch of sardines and all other fish from 1915 to 1925. In 1925 the sardine catch amounted to more than three times the total catch of all other fish combined.

The other faction wished to use a reduction process to extract sardine oil to be used in connection with vegetable oils for human consumption.

At the legislature of 1925 the out-and-out reduction interests, backed by state organizations which wished a cheap fertilizer, showed a great deal of strength and before the bill of the canners was put in final form by the Fish and Game Commission's attorney, the canners became alarmed and entered into a compromise agreement with the reduction interests under which an independent reduction plant could receive five hundred tons of sardines per month for reduction purposes, and the canners were to get sardines for their reduction plants up to 25 per cent of the canning capacity of their canneries. The manufacturers of sardine oil and fish flour for human food were also to be taken care of. The Fish and Game Commission was asked to agree to this compromise with the explanation that if the Commission did not agree to this the reduction interests would go after a wide-open reduction bill and that the canners would join with them. This stand was backed by all of the southern California canners and by about half of the Monterey canners. It was the Fish and Game Commission's belief that under the circumstances its opposition would not prevent the passage of a wide-open reduction bill, so it elected to remain neutral with the understanding that the Commission's attorney should put the teeth in the bill for its easy enforcement. The attorney also drew up the entire bill in accordance with the agreement between the canners and reduction interests. When the bill came up before the Senate Fish and Game Committee the Commission stated its attitude of neutrality. The committee, however, showed itself to be opposed to the idea of allowing independent reduction plants to exploit the sardines and a subcommittee was appointed for the purpose of amending the bill. The final result was the elimination of the provision whereby independent reduction plants could use five hundred tons of sardines a month. The bill provided that canners could use sardines in a reduction plant up to 25 per cent of their canning capacity and the capacity was to be determined by the number of pound oval can closing machines installed and intended to be used during the season. For each such machine installed they were to get one hundred and fifty tons each month for reduction purposes. The bill also provided for the manufacture of food from sardine oil and from fish flour. This bill passed and became a law.

When the question of enforcing this law came up in the fall of 1925 it was found that many of the canners believed the law gave them the right to run one hundred and fifty tons of sardines a month in the reduction plant for each line of pound oval closing machines installed whether they ran them or not, and a number of them put in extra lines of closing machines to increase their capacity and enlarge their reduction plants accordingly. The Commission believed the special privilege to canners was based on the good faith of the canner and that he must run his machines to capacity to get his capacity allowance for reduction. In an attempt to reach an agreement with the canners on this matter, all canners were invited to a conference at the Commission's office in San Francisco, but it was poorly attended and no agreement was reached. The Commission finally decided to enforce the law on the theory that to be entitled to the 25 per cent for reduction purposes the canner must operate each machine to capacity and that if he operated it at less than capacity his allowance was reduced accordingly. To make it simpler of enforcement, the Commission notified the canners that it would consider they had complied with the law if they canned what would amount to 75 per cent of the catch. This was apparently satisfactory to the canners at Monterey, where the sardine season commences in July, but when the season began later in southern California the canners in the Los Angeles district organized to contest the Commission's interpretation of the law. The litigation lasted throughout the season, during which time the canners adhered very closely to the Commission's order.

The first decision of importance was given by the appellate court in Los Angeles, which declared the allowance of one hundred and fifty tons for each line of closing machines to be unconstitutional; but the decision did not state whether the whole special privilege to canners was unconstitutional or just the method of determining capacity.

A later decision in the superior court of Los Angeles County was to the effect that canners were still entitled to 25 per cent of their capacity, but did not enlighten us as to what constituted capacity—whether it was what they actually canned or what they could can. This matter of what constitutes the capacity under the law came up still later in the superior court of Los Angeles County. The judge's decision was still somewhat ambiguous, but he did say that the essence of the matter was the good faith of the canner, and that if his machines and other necessary equipment were not ready and intended to run, his capacity was reduced accordingly. Both sides have claimed a victory as a result of this decision. It would appear, however, from the decision that if a canner was prepared in good faith to run at his claimed capacity he would have to operate up to that capacity before he would be entitled to any overage. This interpretation would give the canner less overage that he would have under the Commission's old order giving him 25 per cent of the catch.

During the past sardine season of 1925-1926, we were able to hold down the percentage of sardines used in reduction plants much better than any previous season in spite of the continued litigation. The amount used in reduction plants was a little less than 25 per cent of the catch, and the pack of canned sardines was greater than the season before although the total catch was less.

A good market has developed for our sardines and the canners, most of them, have changed their attitude in regard to the amount of overage they should have. The time seems right to fix in the law a definite limit to the amount of sardines a canner can divert to his by-products plant, and this amount should be made as low as is possible. What the canners need more than anything is to organize and through a selling agency, or some other legal means, stabilize the price of canned sardines.

During the sardine season of 1925-1926, which lasts from July to March at Monterey and about November to March in southern California, the sardines were abundant during the first two or three months at Monterey but thereafter at Monterey and during the entire season in southern California, the fishermen had difficulty in getting enough to keep the canneries busy. If it had not been for the purse seine fishermen, the season would have been about a complete failure in southern California. These boats being larger can fish farther away from their home port. They had not operated on sardines to any extent before, but when the smaller boats with their lampara nets could not supply the canneries they took a hand. They located sardines near Santa Cruz Island, eighty miles to the north of San Pedro, and from this distance delivered enough sardines throughout the season to save the day for the canners.

In the negotiations between the fishermen and the canners over the price to be paid for sardines during the coming season of 1926-1927, the purse seines have been used as a threat against the lampara fishermen to keep the price down. This more especially applied to Monterey. The price last year was $10 per ton. The fishermen asked $12.50 a ton this season, finally compromising on $11, but not until after two purse seine boats had been brought to Monterey, where purse seines had not been used for quite a number of years. The comparative efficiency of these two methods of catching sardines will be watched with interest.

The provision in the law whereby a reduction process may be used to convert sardines into human food, provided one-half of the wet weight of the fish is used in the process, was taken advantage of by the Bayside Fish Flour Company at Monterey. The fish flour has so far been exported although the company hopes to create a home demand. This process is about the same as in the manufacture of fish meal for fertilizer or stock feed, but it differs in that the ground meal is pressed through fine boulting screens, thus eliminating the bone and all but the finely pulverized muscle fiber. This process is looked upon more or less with suspicion by some of the canners, for it is a reduction process and not much more expensive than the process of making fish meal for fertilizer.

The provision in the law under which sardines may be taken for the oil, provided the oil be used for human consumption, was taken advantage of by two companies—the Globe Cotton Oil Mills of Los Angeles and the Hauser Packing Company of Los Angeles. We believe that this provision of the law is dangerous and contrary to the legislature's policy of confining the use of food fish to the production of human food. The amount of oil in sardines averages about 15 per cent of the wet weight of the fish and so long as this small percentage is used for human food the rest of the fish can be and is used for fertilizer or stock feed. The demand for animal fats such as sardine oil is almost without limit so that there is danger of an immense reduction industry getting started in the state which will seriously deplete the supply of fish and injure the canned sardine industry, the first to be established, the one giving the most people employment and the one which the state has sought to protect. We are confident that if sardines can not be taken directly for this purpose, means will be employed to utilize the oil from the by-products plants of the canneries and we believe that the best policy for the state to pursue, from the standpoint of conservation, is to confine the production of sardine oil to that which may be obtained from the by-products of the sardine canneries.

SALMON.

In our report of two years ago we told of the failure of the law which was designed to stop salmon trolling during certain closed seasons in the sea districts. As recommended in that report, the legislature amended the law but this law has again proven defective. The superior court in Marin County decided that a law is not good which closes one district to the possession of salmon caught outside the three-mile limit while an adjoining district is open. One uniform closed season for the entire coast would not give the salmon the desired protection, for the fish "run" progressively later from Monterey Bay north.

The closed seasons for salmon trolling in the ocean were established in an attempt to save the salmon from destruction, but as has been explained, the law has twice proven defective and the salmon have not received the protection so greatly needed, so that even if those closed seasons could now be made effective the protection would be far from adequate. There are not sufficient salmon remaining to support commercial fishing both within the bays and rivers and in the open sea. Either the outside or the inside fishing should be stopped and to delay further will be fatal. Of the two alternatives, the outside, or sea trolling, should be the one to go. There are many good arguments on both sides of the question, "Should the outside or the inside fishing be stopped?" but the better arguments are for the inside fishing and against the outside fishing. The three main arguments are:

1. The great destruction of immature salmon by sea trolling.
2. Impossibility of regulating the catch of salmon belonging to any one stream so as to maintain the supply of that particular stream race of fish if they are caught in the ocean without knowing to what stream they belong.
3. The industry first started on the river where fishing villages have been built up and where other kinds of fishing can not be turned to, while the fisheries of the ocean are undergoing rapid development and where there are other fisheries to which salmon trollers can turn their attention.

Observations relating to the life history of king salmon have been systematically continued since 1919. A considerable amount of information relating to growth, age, migration, and general habits has accumulated. Some of this has appeared in published form from time to time and other reports are in process of preparation. Both ocean and river catches have been under observation and information has been obtained that will presumably assist in matters of conservation. The work has been under the direct supervision of J. O. Snyder of Stanford University who has been ably assisted in field work by E. C. Scofield and G. H. Clark.

In cooperation with the International Pacific Salmon Investigation Federation an effort was made last year and again this season to place metal tags on adult salmon caught and released at sea. No success followed the first effort, but the second was more fruitful. King salmon to the number of 130 were tagged by Paul Bonnot and C. Rogers in Monterey Bay and off the coast in the vicinity of Eureka. If tagging operations of this kind could be successfully carried out, the results should inform us as to the origin of the ocean catches and furnish data relating to sea migrations, growth, and other matters of importance.

The Commission was represented at the meetings of the Federation which were held in Seattle. Representation here insures cooperation on the part of the state in its investigations.

An outstanding feature of the salmon investigation is the experimental work, part of which has been designed to better acquaint us with the return migration of fishes which have been artificially propagated. An experiment which promises some results of interest and value is now approaching completion. The experiment was initiated in 1922 when, under the direction of Captain Lambson, eggs were collected, fertilized, and placed in the hatchery at Fall Creek, a tributary of the Klamath. The resulting fry were placed in ponds where they were carefully reared by Mr. E. V. Cassell who afterwards superintended their distribution. The distribution of the fish previously marked was performed in such a way as to give the probable results of the experiment an opportunity to demonstrate whether or not returning fish will seek out and enter certain tributaries in which they were reared or introduced. Upwards of 500 marked fish were secured during 1926, all of which will serve to contribute largely to our knowledge of the migratory habits of king salmon both in the ocean and rivers. Equally good results are expected in 1927 when fishes of the ages of 4 and 5 years will return. This experiment, full details of which are given in CALIFORNIA FISH AND GAME, Vol. 10, No. 1, involved the marking of 153,000 yearling salmon.

The successful completion of such an experiment depends largely upon cooperation on the part of those engaged in fishing, as also officials of the Commission, and results to date have been very satisfactory.

That work of a similar nature may be carefully controlled and kept under more constant observation, it is desirable that an experimental hatchery be provided. It is not necessary that such a hatchery be given over entirely to experimental work of such a nature as to prevent or even seriously interfere with its immediate function as a regular station for artificial propagation. Such a station should, however, be under the direct supervision of an investigator who may plan and supervise the execution of experimental work relating to propagation and distribution. Work on species other than salmon might also be carried on to advantage in such a station. For example, in the pursuit of the salmon investigation, advantage has been taken of every opportunity to study the trout, particularly the steelhead, and some data of value has accumulated. A correct interpretation of some of this data rests upon experimental work and stream observation of an inseparable nature, which might be accomplished with profit, if the facilities of a properly located hatchery were made available.

SHAD.

Shad in the Sacramento and San Joaquin rivers were greatly depleted by heavy fishing during the war, at which time there were no closed seasons or other measures to give them protection. A closed season was adopted which was first in effect during the shad run in the spring of 1918. This protection and later the addition of two more weeks to the closed season has resulted in the steady increase of these fish. The quick response of these introduced fish to restrictive fishing measures is remarkable and almost unique. We know of no other fishery where the recovery has been so quick and so unmistakable.

STRIPED BASS.

Striped bass have been given a great deal of added protection during the past ten years and at the 1923 session of the legislature a very great added protection was given by adding two weeks to the spring closed season. Each two years, when the legislature met during that period, some measure was passed to give striped bass more protection without waiting to see the result of the protection given two years earlier. As the striped bass do not spawn until they are four years of age, no noticeable effect of a protective measure could be seen in two years, except possibly in an increased number of very young fish. The measure of 1923, adding two weeks to the closed season, did not go into effect that year until late July, which was after the spawning run of bass was over for that year, so that we can not have any four-year fish, which average a little less than three pounds, resulting from the spawning fish first protected by the two weeks closed season, until in the year 1928.

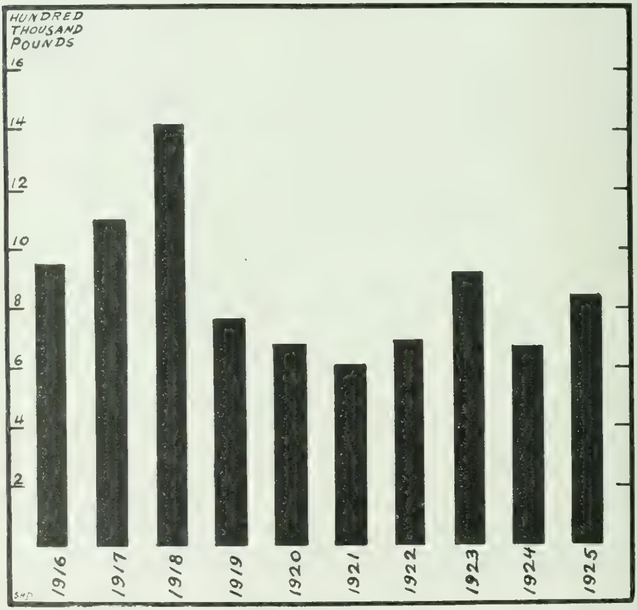


FIG. 12. Graph showing the annual catch of striped bass from 1916 to 1925.

To give striped bass more protection now would not only be taking action without awaiting the results of the last legislation, but it would be done in the face of good evidence that the bass have already responded to the protection given them in the years prior to 1923 and are now actually increasing in abundance.

To get at the abundance of any species of fish through the individual opinion of anglers or commercial fishermen is to be very inaccurate, and at best the result can be only a rough guess unless there is some system for recording the many separate experiences of fishermen and analyzing the data thus gathered. It so happens that we have a system of recording the catches of commercial fishermen—the best that is in existence in any state. This system was put in by state law some eight years ago for the very purpose of determining the increase or decrease in the abundance of any species of fish which is being utilized for commercial purposes, and to do away with guesswork. This system, which gets every commercial fisherman's daily catch together with the type of fishing gear used, gives us the best measure which is known for determining the abundance of fish. The evidence from these records shows that striped bass are not only holding their own but are actually increasing in numbers. And we have not yet had time to experience the benefit from the two weeks added closed season.

PURSE SEINES.

About ten years ago purse seines were introduced into southern California, where they worked almost entirely out of San Pedro. Their first success was in catching bluefin tuna, but they caught a number of other kinds of fish, among them barracuda, of which they occasionally made very large catches, and there were times when they killed more fish than they could get aboard their boat. The catching of barracuda by these purse seines was objected to very strenuously by the barracuda gill net fishermen of San Diego. They took their fight to the legislature in 1923 and got a bill through both houses which would have prohibited the possession of a purse seine with less than four-inch mesh. If the Governor had not vetoed this bill, the purse seines would have been unable to catch small fish like the barracuda, mackerel or sardine. Under those circumstances it would not have paid them to operate, and they would have been eliminated entirely.

At the 1925 session of the legislature the same bill was passed again, this time without opposition, but was held up by the author and a compromise measure was put in another bill sponsored by the Fish and Game Commission, which prohibited purse seines or round haul nets from being used to catch barracuda. This became the law in July, 1925.

It was claimed by the opposition to purse seines that they caused great fluctuations in the price of barracuda and that if purse seines were eliminated the gill net fishermen could supply the markets with barracuda during the winter months as well as the purse seines were doing it. It did not work as the gill net fishermen claimed. The fluctuation in the price of barracuda has been much greater since purse seines were barred from catching these fish, and the gill net fishermen have not been able to supply the markets during the winter, as they claimed they would. This is shown very clearly in a report by Joe Craig, assistant in the State Fisheries Laboratory. As this purse seine controversy is a very important one from a number of standpoints, we are publishing the report of Mr. Craig.

Purse seine boats are larger than the average sea fishing boat in this state and for that reason are highly desirable for relieving the fishing grounds adjacent to ports by fishing farther banks than the smaller boats can.

As the fisheries of San Diego and San Pedro expand, that expansion must take place largely in Mexico. The purse seine boats are of advantage in this distant fishing. During the past sardine season, as already described under the title of "Sardines," these boats were a great boon to the sardine canners of San Pedro in bringing sardines from a distance when they were scarce near at hand. If the four-inch mesh bill for purse seines had become a law at the last legislative session, the sardine season would have been a disastrous one for the San Pedro canners.

INVESTIGATIONS.

The work on king salmon has been continued under the direction of Professor J. O. Snyder of Stanford University. Efforts to secure marked fish have continued with some success. The first experiments in marking troll caught salmon were undertaken in order to definitely determine the native stream of the salmon found in the ocean along the north coast. Briefly summarized, the investigation has shown:

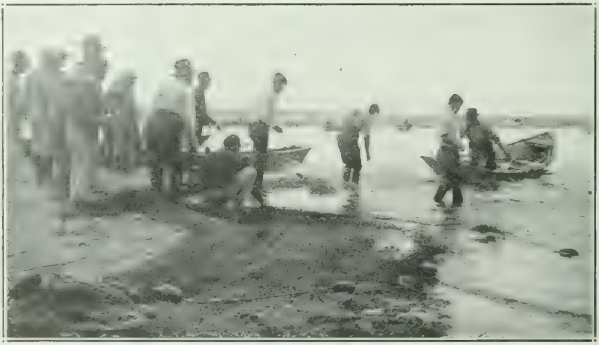


FIG. 13. Seining salmon for marked fish at the mouth of the Klamath River. A study of returned marked fish has greatly increased knowledge relative to the age, rate of growth and migrations of the king salmon. Photograph by Mrs. Ruth K. Roberts.

> Pond bred king salmon return from the ocean to the stream in which they were reared.
>
> Salmon return to the stream in which they were reared rather than to that of their real parentage.
>
> In seeking the parent stream on their return migration, they may pass the mouths of other rivers in which the same species is native.
>
> The nuptial migrations of individuals with the same stream history, but of different age groups, are very regular in time.
>
> Artificially propagated king salmon appear to reach about the same age and stature, and to attain about the same yearly growth as others.

> There is evidence which leads to the inference that king salmon after entering the ocean may remain together in the same locality or migrate in the same school for one or more years, possibly throughout life.
>
> King salmon may range a long distance at sea from the mouth of the parent stream, a discovery of importance in relation to conservation.

It can be seen, therefore, that as a result of marking experiments, a great deal has been learned regarding the salmon's range at sea from the different rivers. Consequently, with this data at hand, the Commission is in a far better position to properly regulate river and sea fishing for salmon in order that the salmon run may be conserved.

Scale studies of the half-pounder of Eel River, which has been believed a salmon by many anglers, is in reality a steelhead trout, approximately three years old, which has entered the river on its first nuptial migration. If this fish is allowed to spawn and escape the dangers of the river, it may return again and again, each time greatly increased in size and presumably with a larger egg-laying capacity. With this knowledge, angling should be so regulated to provide sufficient safety for the needs of the steelhead trout in the Eel River.

Also under the direction of Dr. Snyder, investigations relative to the age and rate of growth of the striped bass as evidenced by scale studies have been started by E. C. Scofield. These studies have shown that a majority of bass mature in their fourth year and at a size which escapes through the nets of minimum sized mesh, set at 5½ inches.

REPORT OF THE STATE FISHERIES LABORATORY.

By W. L. Scofield, Acting Director.

In the last report (twenty-eighth Biennial Report, pages 14-15 and especially pages 53-71), the nature and purpose of the research program of the department was so clearly set forth that the present report may well confine itself to the developments during the last two years.

Of the thirty-five or forty fisheries of California that rank as important, but eight or ten species are the subject of research by the department, due largely to a lack of available funds and trained personnel. The policy has been to confine the work to a rather limited field where reliable and fundamental work may be accomplished rather than to attempt to cover superficially a larger field.

The work of the State Fisheries Laboratory is intended as a basis for future work of the department. As an essential part of the program, it is striving to establish the principles governing the fluctuations in abundance of the fish supply and the methods by which the first signs of overfishing may be detected. This attempt to establish fundamentals is best developed in a still more limited field.

The chief work of the laboratory has, therefore, been largely confined to the two most important species of the state, the sardine and the albacore. Although valuable contributions have been made by the laboratory concerning other species, such work has been more in the nature of meeting emergency requirements, rather than the determining of underlying principles to serve as a basis upon which to build future work.

Personnel.—Since the submission of the last report, the personnel of the laboratory staff has changed greatly. The director, Mr. W. F. Thompson, was honored by being chosen to direct the halibut research work of the International Fisheries Commission, with headquarters at Seattle, and is now on leave of absence from the state while so engaged. Mr. Thompson, however, continues his albacore research work for the state, and, by means of frequent visits to the laboratory, continues to give valuable assistance in directing and advising as to the carrying out of the research program. During his absence, W. L. Scofield is acting director of the laboratory.

But two of the former staff members remain, the vacant places having been of necessity filled by inexperienced students. The staff has been enlarged from seven to ten; but of these ten, only three are as yet capable of independent research work. The condition noted in the twenty-eighth Biennial Report (page 56) is even more apparent now. As soon as workers have received sufficient training to do effective fisheries research, they are attracted elsewhere by more promising positions, at higher salaries than the state is now paying for this specialized investigative work. Since the demand for such workers is increasingly great, it is obvious that we will have to offer greater inducements to such men if we hope to retain a nucleus of trained research workers.

Students, under the personal direction of an experienced man, are capable of doing the field work of gathering the necessary statistical data, but only trained men of specialized experience are capable of doing the analysis and investigative work that will produce results from the data gathered. The research work of the laboratory is now seriously handicapped by the lack of experienced men. This situation promises to become more, rather than less, acute in the future, due to the increasing demand for men of training in such work.

In addition to the state employees, there are now three members of the laboratory staff employed by the International Fisheries Commission, United States-Mexico; one of whom is receiving training in research methods, and two are engaged in the arranging and filing of the state's records of catch.

Sardine Work.—The sardine catch of California outranks, in pounds landed, the commercial catch of all other fisheries combined, by three to one, and promises to increase in importance and to maintain its lead over all other fisheries for many years in the future. This is the chief reason for our concentration of research effort on the sardine fishery.

The results already attained form the entering wedge to our understanding of the complex changes occurring in our sardine fishery. Summaries of these results are to be found in the five reports assembled under the title Fish Bulletin No. 11.

The data for more detailed analysis are at hand, but fisheries experts of advanced training are necessary for this follow-up work, and at present such men are exceedingly difficult to find and hold. With the staff available, this work is being pushed as far as possible. The sampling and analysis of the catch at semiweekly intervals is being continued, and the observations will be summarized after the close of each fishing season.

Albacore Work.—The results of several years' observation and research work on the albacore catch are now being prepared for publication by Mr. W. F. Thompson. An analysis of boat catches over a period of years will form a part of his report. Regular daily observations of the catch of southern California for the three summer months will be continued.

Pismo Clam Work.—Since the publication of Dr. Weymouth's Fish Bulletin No. 7, on the Pismo Clam, the work has been continued and a surprisingly rapid depletion of this species has been clearly demonstrated. The evidence is now being prepared by W. C. Herrington for publication in bulletin form as one of the Fish Bulletin series.

Striped Bass Work.—Biological and life history research of the striped bass is being carried on by E. C. Scofield under the direction of Professor J. O. Snyder at Stanford University. In addition, a preliminary boat catch analysis covering the last eight years has been prepared at the laboratory by J. A. Craig. Although this boat catch analysis is preliminary in nature it is planned that the catches of this species will be subjected to further analysis, and together with similar work done on albacore, the results may be summarized in bulletin form, so that the relative merits of the various methods of analysis can be contrasted, to serve as a guide to possible future work along such lines.

Miscellaneous Research.—Various secondary research problems have received attention during the last two years; for example, observations on the catches of rock fish and smelt. Such work, in the absence of intensive study, will require an accumulation of observations over a period of years before the results should be summarized. In the meantime, the preliminary information so gained will serve as a valuable basis for future work on these species in case the program is enlarged to include these fisheries.

Publications.—During the last two years four Fish Bulletins, numbers 8, 9, 10 and 11, have been issued, as well as various magazine articles appearing in the quarterly, CALIFORNIA FISH AND GAME.

Fish Bulletin No. 8 by Mr. Carl L. Hubbs of the Museum of Zoology; University of Michigan, deals with racial and seasonal variations in the Pacific herring, California sardine and California anchovy. Fish Bulletin No. 9 by Dr. Tage Skogsberg presents in bulletin form the report on the purse seine industry of southern California. Fish Bulletin No. 10 by Dr. Frances N. Clark (now returned to the staff of the laboratory) deals with the life history and spawning habits of the grunion. Fish Bulletin No. 11, as already noted, deals with the California sardine and includes five reports on research work done by members of the laboratory staff. Two of these reports are by W. F. Thompson, and one each by O. E. Sette, Elmer Higgins and W. L. Scofield. More detailed reference to the character of the work reported in these four bulletins is contained in the last biennial report (pages 56-58).

Statistical Data.—As explained in previous reports, the statistical information on the fish catch and fishing industries, as gathered by California, is unique because of its completeness and accuracy. Valuable and necessary information is systematically collected covering the fishery products, investment in canning and fishing equipment as well as the types of boats and fishing gear used, but the distinctive data for value and completeness are to be found in our catch records. These show not only totals for each species for each locality, but in addition show the individual boat catches daily. These records are the foundation for our knowledge of the fisheries of the state, and much of the research work is dependent on data taken from our so-called "pink ticket" boat catch records.

During the last two years much progress has been made toward further systematizing the collection and proper filing of these records, as well as the correction of minor errors or omissions, with the result that this information as a whole is of an increasingly high standard of reliability.

The presentation of this information to the public has necessarily been somewhat neglected while the plans for collecting the data were being perfected, but the time is now ripe for publishing the results obtained from our statistical system in more detail, together with summaries and graphs to make the information more readily grasped by the people of the state. Plans for such publications are now under way.

LIBRARY FACILITIES FOR FISHERIES RESEARCH AT THE CALIFORNIA STATE FISHERIES LABORATORY.

Accessions.—Noteworthy improvements in library facilities for ichthyological and fisheries research have been made at the California

State Fisheries Laboratory during the past biennium. Over 100 books were purchased, and an aggregate of about 90 sets or parts of sets of serial publications were received between July 1, 1924, and July 1, 1925. At least eighty of these were obtained in exchange for Fish Bulletins Nos. 2-10, and various reprints from CALIFORNIA FISH AND GAME. Most of them are series of which no numbers were previously in the library. In addition, a great many separate back numbers, odd volumes and reprints have been obtained to fill out partial sets already in the library. Since July 1, 1926, another 20 exchanges have been arranged, eleven new subscriptions have been started, and a large number of other items have been requested.

Several hundred volumes much in need of binding are now well bound, so that loss of loose pamphlets is prevented, and the books are protected from dust, as well as being much easier to consult than they were formerly.

Card Bibliography.—Considerable progress has been made in building up a useful card bibliography. This has as its basis the cards on fish printed by the Concilium Bibliographicum. These represent a number of books, and more than eight thousand scientific papers from no less than eight hundred and thirty-five distinct serial publications. They have been prepared by consulting whatever volumes (from 1896 to date) of various series which happened to be available to the Concilium's staff. At first thought one might easily suppose that here was everything for the period covered that a scientist investigating fishes could possbily desire. However, it has been found, by careful analysis, that these cards give very incomplete access to fisheries literature. For our work they are accordingly being supplemented by printed cards from the Library of Congress, John Crerar Library, Queen's University Library, and other sources, and, when these fail, by our own typed cards. All are being combined into one alphabetic arrangement. When this is brought up to date, it will enable an investigator to locate articles by species, by subject and by author. (In most large libraries he would be able to find *books* on fishes in this way, but not the articles in specialized scientific periodicals.)

Union List.—A red star on the card shows when a paper sought is to be found in this library. If it is not here, reference to the recently published "Union List of Periodicals in the Libraries of Southern California" often locates a copy in some nearby library, which may be obtained by inter-library loan. The above publication, which lists some of the holdings of the California State Fisheries Laboratory, is a very useful document, and the California Fish and Game Commission may compliment itself upon having helped to finance its publication costs.

Care has been taken not to duplicate unnecessarily work already well done by the editors of the various printed indexes to zoological publications. It is intended to have our catalog furnish additional aids which these guides lack.

Distinctive Service.—The library collection now contains the equivalent of about twenty-five hundred volumes. Its highly selected character is one of its most significant features. There is no attempt to acquire complete sets of journals unless they are largely devoted to marine biology. Many separate numbers and volumes from general scientific series, are, however, on the shelves, since these contain papers of importance to fisheries investigation. The result is that in a relatively small space is concentrated a quantity of material, all of which bears more or less directly on the subjects that are of primary concern to the users of the library. Working at a university library, our men usually find that in order to assemble the various papers needed for a particular problem, they must consult two or three different departmental libraries as well as the general university collection. This annoyance is of course spared them here. Our distinctive contribution to fisheries research is, therefore, satisfaction of the specialized demands of scientific work in a limited field. A university librarian can not possibly give so much attention to *all* of the many interests he must serve, and therefore he usually gives it to *none* of them.

The fact that a number of investigators working at various points along the coast for other commissions, not infrequently come to the California State Fisheries Laboratory to do their reading, is evidence that our service is appreciated.

Future.—Prospects for library development during the coming fiscal year are very encouraging. Apparently more funds are available for 1926 than were for either 1924 or 1925. The plan is to employ a full-time librarian with zoological training and a clerical assistant, whereas the work of the past two years has been handled by this assistant and a librarian who worked, on the average, only about three days a week. The records are now in such shape that progress in both ordering and cataloging is much easier than it was in 1924. The obvious needs of the library, aside from the acquisition of more volumes, are further work on the card bibliography, binding, and subject classification of the reprint collection. If present plans are carried out, and adequate support is maintained, the library should increase its usefulness very greatly before the 1928 Biennial Report goes to press.

REPORT OF THE LEGAL DEPARTMENT.

By B. D. Marx Greene, Attorney.

Prior to January, 1926, the legal work of the Commission was handled by a general attorney with headquarters at Sacramento and by an attorney for the Commercial Fisheries Department with headquarters at San Francisco. In January, 1926, upon the reorganization of the Commission, the two legal positions were consolidated with that of the executive officer, and an assistant attorney, Ralph W. Scott, was appointed to serve at San Francisco.

The legal work of the Commission is divided into certain main classifications:

1. The prosecution in the justice's court of cases involving violation of fish and game laws where assistance is requested by district attorneys of counties. This usually happens when technical provisions of the law are in question or when a jury has been demanded. Usually the game wardens prosecute their own cases and do not call for assistance unless some unusual legal question is presented or a jury is demanded.
2. Superior court actions for injunction brought in the name of the people of the State of California through the office of the attorney general in which the attorney for the Commission appears of record and actually handles the legal proceedings.
3. Actions commenced in the superior court against the Commission, or individual employees of the Commission in their representative capacity, either to compel the performance of a certain duty or to enjoin the Commission and its officers from performing some specific function.
4. Original applications to either the appellate or Supreme Court to compel the Commission to take action or to desist from taking action.

The following is a summary of cases handled by the legal department of the Commission during this biennial period:

SUPREME COURT.

People vs. *Monterey Fish Products Company*, 69 Cal. Dec. 261. Decided March 4, 1925.

Action brought in the superior court of Monterey County for injunction to prevent defendant from operating an independent reduction plant using sardines for fertilizer purposes. The superior court decided in favor of the defendant. The case was appealed to the Supreme Court and reversed. This is now one of the leading cases in California and the nation in regard to state ownership of fish and game in its sovereign capacity and lays down certain general principles relative to waste of food fish and the right of the state to regulate its taking and use.

In re Berto, 69 Cal. Dec. 420.

Original application to the Supreme Court for a writ of *habeas corpus* upon the ground that the offense charged in the original cause in justice's court was insufficient because it failed to allege that the beach net or seine which was being used in violation of law was used for the particular purpose of taking and catching fish. This decision liberalized the law and makes it much easier hereafter to charge similar offenses. This case is interesting because the Commission convicted the defendant in justice's court and appeal was taken to the superior court of San Mateo County and the judgment sustained. A request for a writ of *habeas corpus* was made to the appellate court and denied and, finally, the same question was passed upon by the Supreme Court in this case.

In re Angelo Biardo, 69 Cal. Dec. 420. Same as above.

In re Jack Biardo, 69 Cal. Dec. 420. Same as above

In re Cerruti, 69 Cal. Dec. 420. Same as above.

In re Spurtino, 69 Cal. Dec. 420. Same as above.

DISTRICT COURT OF APPEAL.

Van Camp Sea Food Company vs. *Newbert et al., Commissioners*, 49 Cal. App. Dec. 38. Decided December 23, 1925.

This was an application for *certiorari* to review an order of the Fish and Game Commission regulating the amount of fish used in the manufacture of fertilizer by fish canning plants. The Commission contended that the application should be denied because the act of the Commission was not of such a judicial nature as to justify a proceeding *in certiorari*. The court held that the Fish and Game Commission had no right to exercise judicial functions and if, therefore, in fact, this function attempted to be exercised by the Commission was either judicial or quasi-judicial, the writ would not lie.

Stafford Packing Company vs. *Newbert et al.*, 49 Cal. App. Dec. 41. Same as previous case.

Pacific Marine Products vs. *Newbert et al.*, 49 Cal. App. Dec. 41. Same as previous case.

Southern California Fish Corporation vs. *Newbert et al.*, 49 Cal. App. Dec. 41. Same as previous case.

Los Angeles Sea Food Products Company vs. *Fish and Game Commission*. 49 Cal. App. Dec. 41. Same as previous case.

Franco-Italian Packing Company vs. *Newbert et al.*, 49 Cal. App. Dec. 41. Same as pervious case.

Van Camp Sea Food Company vs. *Newbert et al.*, 49 Cal. Dec. 362. Decided February 25, 1926.

This is a companion case to the other Van Camp case above, but here the plaintiff seeks mandamus to compel the Commission to issue a new order relative to the amount of fish to be used for manufacture of fish meal. The court, however, adopted the interpretation of the fish reduction act claimed by the Fish and Game Commission and declared that portion of it unconstitutional on which the plaintiff relied. The demurrer to the petition was therefore sustained and the writ discharged.

People vs. *James A. Makings*, No. 1323, First Appellate District, Division Two. Decided May 17, 1926.

An application for a writ of *habeas corpus* directed to a constable of Sausalito township to secure release of petitioner from custody on a charge of transporting crabs from fish and game district 1½. This raised the question of the constitutionality of section 623 of the Penal Code which prohibits the exportation of crabs from certain designated districts in northern California. The constitutionality of the law was upheld and the writ denied.

SUPERIOR COURT.

People vs. *Globe Cotton Oil Mills.* Action filed in the superior court of Los Angeles County in January, 1925, for an injunction to prevent the defendant from using whole fish for reduction purposes to make an edible oil product. On February 3, 1925, the injunction was granted as prayed for in the complaint. Subsequently, when the new reduction act was passed by the legislature in 1925 the action was dismissed.

People vs. *Hovden Company.* This action was filed for an injunction October 23, 1925, in the superior court of Monterey County as a result of alleged overuse of sardines for reduction purposes by the defendant. Temporary restraining order granted and on November 14, 1925, by stipulation injunction *pendente lite* granted restraining defendant until further order of the court from violating the orders of the Commission relative to the amount of fish to be used for reduction purposes.

People vs. *Pacific Marine Products.* Action filed in the superior court of Los Angeles County January 29, 1926, to prevent the defendant from using fish for reduction purposes in violation of law. Action still pending.

People vs. *Gilbert Van Camp.* Same as previous case.

People vs. *Italian Food Products Company.* Same as previous case.

People vs. *Franco-Italian Packing Company.* Same as previous case.

People vs. *Battagalia et al.* In the superior court of Marin County. Appeal from the justice court of Sausalito township involving a question of illegal use of nets. Action still pending.

Lowe vs. *Carpenter.* In the superior court of Glenn County for injunction to prevent seizure of 270 geese used as decoys. Action still pending.

CASES INVOLVING INSTALLATION OF SCREENS.

A large number of injunction cases are pending at the present time to compel the installation and maintenance of fish screens in irrigation ditches and canals. Very few of these cases have been pressed since the reorganization of the Commission, as a new bureau has been installed to care for these matters and a general survey of the state is being made at the present time. Until this survey is completed most of the cases have been left in abeyance.

CONDEMNATION OF NETS.

Under section 636*a* of the Penal Code, it is the duty of the Fish and Game Commission to commence proper proceedings in the superior court to condemn all nets seized for violation of the fish laws. In compliance with this section the Commission instituted 73 separate proceedings in the courts of this state for such condemnation and in each instance obtained from the superior court an order of condemnation.

OPINIONS.

In addition to the court proceedings, the legal department of the Commission renders numerous opinions, both formal and informal.

Also, for the guidance of the Commission, we are greatly indebted to U. S. Webb, Attorney General of the state, who has at all times cooperated with us to the fullest extent in handling such legal proceedings as were necessary, and in giving us formal and informal opinion, suggestions and advice.

REPORT OF THE BUREAU OF EDUCATION AND RESEARCH.

By HAROLD C. BRYANT, In Charge.

EDUCATION.

LECTURES.

A greatly increased demand for lectures has been noticeable during the past biennial period. Outstanding has been the demand from service clubs. Numerous conservation lectures have been furnished Rotary, Kiwanis, and other service clubs. School requests have also been unusually heavy. Although the majority of lectures have been given at high schools, yet grammar schools have come in for a fair share. Boy Scout and Camp Fire organizations have been furnished numerous lectures and field trips. As in the past, contributions to scoutmasters and leaders training courses have been considered most valuable in that through the training of leaders the gospel of conservation is more easily spread. In the spring of 1925, six lectures on fish and game were given in a university course in Forestry 1, as in former years.

Preceding Christmas, 1925, the San Francisco *Bulletin* imported a team of reindeer from Alaska. These deer attached to a sleigh and accompanied by a Santa Claus were shown to thousands of San Francisco school children. Since the exhibition to schools gave a worthwhile opportunity to give a lesson in big game conservation, a lecturer was furnished by this bureau. After a discussion of the life history and habits of the reindeer attention was called to the need for conservation of other members of the deer family.

Under the direction of the county superintendent of schools, Sonoma County teachers emphasize bird study during the fall months. Last year, this special study ended with a midwinter contest participated in by children throughout the county. A lecturer from this bureau showed various common birds on the screen and the children were expected to write down the name. All those who accurately named twenty-five or more birds were given a badge.

Three lectures have been broadcasted over the radio. Returns have shown large audiences not limited to California, but distributed throughout the west. Executive officer, B. D. Marx Greene, has also utilized this means of carrying a message to western sportsmen and nature lovers.

Considerable aid in the educational program has been given by employees outside the Bureau of Education and Research. In recent months the commissioners themselves have given many talks before fish and game protective associations and the executive officer has been especially active in aiding this necessary work. Lectures have also been given by Rolin G. Watkins, in charge of publicity, Jay Bruce, state lion hunter, and August Bade, superintendent of the Yountville Game Farm. Talks in schools and before other organizations have been given by many of the deputies.

Reference to the following table will show a total of 166 lectures with an attendance of 42,366. This added to the total attendance for the summer resort work makes a grand total of more than 137,000 persons who have heard a conservation message by medium of the spoken word.

Attendance Record Lectures, Bureau of Education and Research, July 1, 1924, to June 30, 1926.

Organization	*Number of lectures*	*Attendance*
High schools	47	21,295
Grammar schools	10	3,850
Universities and colleges	11	2,160
Civic and public	21	6,065
Service clubs	17	1,090
Fish and game protective associations	10	914
Boy Scouts, Campfire Girls, etc	15	1,694
Radio	3	----
Miscellaneous	27	2,298
Motion picture film only	5	3,000
Totals	166	42,366

FIG. 14. A group of Boy Scouts from Oakland who received field instruction on game and game conditions while visiting Yosemite National Park, summer of 1926. Photograph by B. C. Cain.

NATURE EDUCATION.

Attempts have been made to stimulate the teaching of nature study and conservation in the public schools. Through a committee at the University of California, nature study work has been actively espoused. Emphasis is especially needed now since the law, making nature study compulsory in the public schools, was repealed at the 1925 session of the legislature. Thousands of helpful publications have been furnished school teachers at their request. Every opportunity has been taken through interviews to encourage teachers to emphasize nature study and conservation. A large number of donations of birds' eggs and other specimens have been made to various schools and museums for use in objective teaching. Many loans of lantern slides have also been made to teachers.

Aid to various boy scout organizations was also furnished through activities in supervising the passing of bird study and conservation tests. At least three employees of the Commission have been actively engaged as examiners. A training class for scouts wishing to pass bird study and conservation tests was given instruction two different terms. Campfire girls and girl scouts were given like help.

During the fall of 1924, preceding the referendum on the Klamath River Fish Reservation, an extensive campaign of education and publicity was instituted. Numerous publicity items were furnished the newspapers and many lectures were given. Undoubtedly this campaign played a definite part in our having the victory which helped to save the fish resources of the Klamath River.

SUMMER RESORT EDUCATIONAL WORK.

Continuing the cooperative arrangement with the National Park Service, nature guide work has been continued in Yosemite National Park each summer. The work has grown continuously and a staff of seven or eight men is now necessary in order to serve the thousands of people who make use of the nature guide service. It is undoubtedly the largest effort in popular nature education yet undertaken. It has been gratifying to note its spread to other parks. Through the medium of lectures and campfire talks, field trips, exhibits and office hours, the service attempts to awake vacationists to natural history opportunities and to their responsibility as regards wild life conservation.

FIG. 15. Yosemite School of Field Natural History pursuing field studies in Yosemite National Park. This school, run in cooperation with the National Park Service, is one of the contributions to nature education being made by the Bureau of Education and Research of the Fish and Game Commission. Photograph by Mrs. Elizabeth Fitzgerald.

From the standpoint of accomplishment there are three things that stand out as a result of the last two summers' activities of the Yosemite Nature Guide Service: a training school for nature guides and teachers;

extension of the program to back country camps and increased interest and attendance.

Twenty students were enrolled in the Yosemite School of Field Natural History each session. The course included a six weeks' study of living forms in their natural environment plus a week's study of conditions at higher elevations. These students have gone back to their occupations filled with worthwhile knowledge of fauna anl flora and with new ideas relative to conservation. What they learned will be passed on to the students in their schools and to their friends, thus widening the field of endeavor. In this group will also be found trained men and women capable of starting similar educational work in other summer resorts another year. A special campfire with natural history lore as a special attraction was another innovation.

It was possible the past two years to place a nature guide at outpost stations, thus giving equal opportunities to those staying at back country camps. Though numbers handled were smaller at these outposts, compensation was to be found in the more intimate contact and the notable enthusiasm. At the higher elevations mammal life is more abundant and opportunities for study of the more unusual forms more frequent. Angling conditions being better, a study of fish life and protective measures necessarily became easier.

More than seventy-five applications for the 1927 session of the school have been received and consequently the limiting of the number to twenty is becoming increasingly difficult. A similar school is to be started next year in New England by a former member of the Yosemite staff.

Attendance Record,
Yosemite Nature Guide Service,

	Field trips		*Lectures*	
	Number	*Attendance*	*Number*	*Attendance*
July-August, 1924	120	1,679	142	21,534
May-August, 1925	494	9,912	303	49,590
May-June, 1926	126	2,682	100	23,923
Totals	740	14,273	545	95,047

EDITORIAL AND PUBLICATIONS.

During the biennial period eight numbers of CALIFORNIA FISH AND GAME have been issued, two of which were special numbers, the Klamath Conservation Number issued July, 1924, and a Striped Bass Number, April, 1926. A special article by Jay Bruce, state lion hunter, entitled, "Problem of Mountain Lion Control in California" attracted more than ordinary interest and there has been continuous call for copies of this article. Volume 11 contained 202 pages and 48 illustrations. Separates were obtained of eight of the more important articles. Call for such separates is continuous.

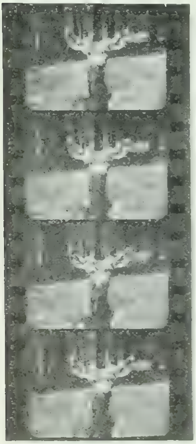
The edition continues to be 7500 and close to 6500 of each edition are mailed to libraries, schools and individuals. There has been considerable call, especially from libraries, for needed copies to complete sets. We regret to report that the supply of the first number, issued in 1915, is entirely exhausted and the supply of several numbers is limited and consequently distributed only to libraries that wish to complete their files.

The 1924 biennial report comprising 112 pages was compiled and issued in the fall of 1924. Three Fish Bulletins, numbers eight, nine and ten have had our editorial supervision. Teachers' Bulletin number eight, "Fish and Game Laws and the Reasons for Them," was issued in the spring of 1926 and judging by the numerous requests from schools has filled an important need. Plans are being made for the revision of "Bird Study in the Public Schools." Miss Gretchen Libby, the author of this bulletin which is now out of print, was employed during the month of June, 1926, to partially prepare the bulletin for republication. Hundreds of requests for this bulletin are on file and it will be a pleasure to again be able to fill these orders.

More than twenty-five popular and scientific articles have been published in various periodicals. Among the subjects treated were Fish Resources of the Klamath River, Hawks That Are Blacklisted, The Lion Hunter of San Lorenzo, Maintaining a Supply for the Creel, and Nature Guiding.

MOTION PICTURES.

The end of the fiscal year finds this bureau with a partially replenished library of conservation films. Certain of the Salisbury films first secured in 1915 have been entirely worn out and those which replaced them have also become worn and scratched. It was possible during 1925 to secure an additional copy of the colored motion picture film showing operations at the Mount Shasta Hatchery. In the spring of 1926 a new reel showing some non-game birds and additional material for game bird reels was purchased. This together with personally taken material gives us eight reels in fair condition. Effort has been made to secure negative as well as positive so as to more readily replace worn reels. There is still need for replacement of worn films. Particularly is there needed a film portraying the work of state lion hunter, Jay Bruce, and operations at the Yountville Game Farm. It is expected that these will be secured during the coming year.



A regular booking system recently installed has helped in handling the increasing demand for the Commission's educational films. Films borrowed by the Associated Sportsmen's Clubs have been used on a circuit with a resultant large attendance record. Three different farm advisers borrowed films and used them regularly for weeks at a time.

During the first six months of this year, twenty-five loans were made in addition to the use of films at scheduled lectures.

ROUTINE OFFICE WORK.

Through the years this bureau has had charge of the issuance of scientific collector's permits. In December of each year, the reports of 150 collectors in the state are filed and new permits issued. In most instances, scientific collector's permits are limited to a small number of birds and their issuance is based largely on the actual scientific or educational use to be made of the specimens.

A compilation of hunting accidents has been made and published annually.

Attention has been given the care and filing of sportsmen's magazines and other publications. All such publications are arranged in chronological order and are available for reference. Likewise, a large collection of photographs has been filed and indexed. The complete card index record of the Commission's publications is up to date.

PUBLICITY.

For some time the Commission has needed wider publicity as to its accomplishments and plans. This was finally attained in the spring of 1926 and a separate Bureau of Publicity was established relieving the old bureau of the newspaper publicity. Previous to that time, numerous items on activities of the Commission and on conservation were prepared and mailed to the newspapers. A check showed that these items were widely used by newspapers throughout the state.

Publicity was further attained through lectures, the State Fair exhibit, motion pictures, radio broadcasting, loan of photographs and cuts, and through numerous conferences.

RESEARCH AND INVESTIGATIONS.

Progress has been made on the stomach examination of ducks, looking toward a final report on the food of ducks in California; however, this important project is still incomplete. A number of miscellaneous stomach examinations of birds have been made and the data filed, likewise, a number of identifications have been made for various persons and reports submitted.

During the summer of 1924 special study of the relation of birds and animals to the the foot and mouth disease was made and a report written. Also, the conditions on Lower Klamath Lake were investigated at the request of the United States Biological Survey and a full report rendered.

Several post-mortems made on ducks dying from a peculiar disease in the Sacramento Valley showed the usual signs of alkali poisoning. Splendid help from the veterinary department of the University of California is acknowledged. A number of quail reported as having been poisoned were sent to a chemist and an analysis was made. The results were negative.

In the fall of 1925 quail poisoning experiments conducted by the Associated Sportsmen of California were watched with resultant profit.

Again it was demonstrated that quail may consume large proportions of poisoned grain without injury.

A so-called ''madstone'' taken from a deer sent in for identification proved to be a hair ball and led to a study of the subject. Attention has also been given to the range of individual deer and a report made on evidence secured from a belled animal.

Efforts to improve the research resources of the bureau have been continued. Pertinent material is continuously filed according to subject, and articles appearing in bulletins and magazines are bibliographed.

OUTSTANDING FEATURES OF EDUCATIONAL PROGRAM.

1. Numerous lectures illustrated with motion pictures furnished schools and other organizations.
2. A quarterly magazine entitled CALIFORNIA FISH AND GAME sent to all libraries and educational institutions and to numerous subscribers in addition. This magazine is widely used by biology and nature study classes.
3. A series of teachers' bulletins giving helpful material for use in the school is being prepared and issued.
4. A summer resort educational program in Yosemite National Park teaches more than 50,000 persons through lectures and nearly 10,000 in courses of field study the importance of conservation. A School of Field National History established in Yosemite National Park trains students who will be available to help in enlarging the nature education program.
5. Continual aid given boy scouts, camp fire girls, and girl scout organizations.
6. Continual effort made to encourage the teaching of nature study and conservation in the public schools. Loans of lantern slides, films and specimens are made.
7. Dependable answers furnished to numerous questions relative to the life history and habits of fish and game.
8. Investigations relative to the life history, habits and diseases of various game species prosecuted.

REPORT OF THE BUREAU OF PUBLICITY.

By Rolin G. Watkins, In Charge.

The present director of this bureau took over his duties on February 12, 1926. At that time there was turned over to him by Dr. H. C. Bryant, who formerly had charge of the publicity of the Commission in addition to his educational and research duties, about two hundred names of publications which had been supplied with material relative to the activities of the Fish and Game Commission. The majority of these were California publications, but many of them were published elsewhere throughout the nation. With the institution of a separate bureau, greater opportunity was afforded to acquaint the people of California with the work and aim of the Commission. The director at once set about building up a larger list of California newspapers, many of which were supplied from his own memory, but the majority were called to his attention through our clipping files as papers not supplied with our matter, but which were enough interested in wild life conservation to originate their own material. This list has now grown to more than six hundred California publications, besides many periodicals given over to matter of this sort issued elsewhere.

The present activities of this bureau may be enumerated as follows:

1. Supplying between six hundred and seven hundred newspapers and periodicals with from three to seven stories weekly. These stories are all straight news matter, experience having taught the director that propaganda, of any sort, will react upon the bureau furnishing same, as news editors will, once having been afflicted in this manner, refuse to use further material, regardless of its merit, originating from the same source.

2. Supplying photographs and special stories to such magazines as require them, after once the subject has been broached in general form to our entire newspaper list.

3. Special attention to the publicizing of the activities of the California State Game Farm, at Yountville.

4. Preparation of material to be used in radio addresses by the executive officer and others.

5. The securing of motion picture films of Commission activities, to be used by the Bureau of Education. These are secured without cost to the Commission through arrangement with pictorial news weeklies.

6. Assisting the executive officer by giving lectures before service clubs.

7. Checking, crediting and filing of all the clippings relative to wild life conservation and the activities of the Commission coming to the bureau through Allen's Press Clipping Service. A full and complete record is kept for each month, showing the number of clippings used by each publication on the list, and whether our own material originated in regular news channels, or by special writers. These clippings are furnished the heads of departments and bureaus interested in same for their perusal, and return to the general files.

8. The collection of data for editing and publication of "The Service Bulletin," the monthly publication for the Commission employees.

The director of this bureau is likewise the director of the Bureau of River and Harbor Pollution and gives much of his time to those activities. His work of publicity is done with the assistance of one girl from the executive department.

REPORT OF THE BUREAU OF GAME FARMS.

By August Bade, In Charge.

On December 7, 1925, the first work of construction was started on the site near Yountville that had been chosen as the location of the new game farm. This preliminary work consisted of grubbing out some fifty odd trees and filling up a large ditch that ran through the grounds. With the completion of this work, excavation was begun on the trench for the concrete base upon which the outer wall of the main enclosure was to be built. This necessitated the digging of a trench two feet deep for a distance of 2280 feet. The purpose of this concrete base is to exclude all ground vermin from the main rearing field. It required the services of a power concrete mixer and twelve men to lay this wall in seven days.

While this was being done a man and team were engaged in plowing the ditches in which over 7000 feet of water pipe was later to be laid forming the irrigation system for the 472 pens that the main enclosure was to contain.

Shortly after the first of the year twenty-four pens were built to care for the breeding stock that had been purchased in Oregon. These birds, ring-necked pheasants, arrived on the farm the 12th of January. Later on twenty-four more pens were built to accommodate all the pheasants and some valley quail that had been trapped for breeding purposes. There was not time for cultivation and the proper seeding of these breeding pens, so oak boughs were used as cover during the season. At intervals these boughs were renewed as the hot sun soon dried the leaves.

With the breeding stock taken care of, attention was directed towards the building of the rearing field. It was obvious that no time could be lost as the pheasants would start laying by the first of April. All material had been ordered, but it was a case of getting delivery. The first of seven cars of lumber arrived at the Yountville depot of the Southern Pacific on January 8th. A large truck belonging to the Fish and Game Commission was used in hauling this lumber to the site of the farm, a distance of four miles. It was soon worked into the framework of the structure by a crew of twenty-five carpenters and their helpers.

When it came to the matter of poultry netting, it was found necessary to have this article shipped direct from the factory at Boston, Massachusetts. Fifteen acres of wire netting was the order. The side walls of the pens are made of one-inch mesh wire and the top covering is two-inch. This order of wire came by water on one of the Luckenbach steamships.

While the framework was being put up, an expert plumber and his helpers were engaged in laying the water lines. The pipe for this system ranges in size from 4- to $\frac{3}{4}$-inch galvanized. Rector Creek furnishes the water and it is delivered into each pen under a seventy-pound pressure gravity feed.

It was now evident to all concerned that a race against time was on. The pheasants should start laying by the first of April. Could the construction work be finished? Running true to form, even under the handicap of noise and confusion, the first pheasant eggs were picked up from the breeding pens on March 27th. In less than a month these eggs would hatch. They were held as long as possible before being set in order that a few more days might be had in which to have a few pens ready for the young birds.

On May 1st, the first brood of pheasants hatched and twenty-four pens were finished. The race had been won and the game farm was a reality. From now on, it was a mere matter of finishing more pens and hatching more birds and the pheasant hens were laying quite normally. But at this time, a new problem presented itself. In this particular locality there was a scarcity of Rhode Island and Buff hens, the kind that all game farms bank on for bird production. The writer well remembers driving over one hundred miles in quest of this particular fowl and coming back with no hens and only a few promises for the future.

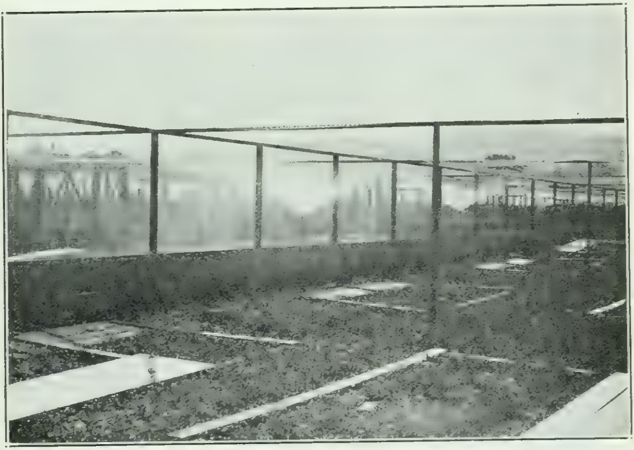


FIG. 16. Rearing pens at the State Game Farm at Yountville, showing the sprinkler system which helps provide green food and cover in half of each pen. Photograph by H. C. Bryant.

The local newspapers and all organizations that could be enlisted were asked to help. The response was good and in a short time it was possible to set the eggs quite readily. In order to further help this condition, incubators were used. Twenty-five hens would be set and at the same time an incubator with 300 eggs would be started. Naturally they would hatch at the same time and the incubator chicks would be given to the hens for brooding and rearing.

As the eggs began to hatch, it was discovered that the fertility was below normal. This was no doubt due to the noise and confusion and the lack of sufficient cover in the breeding pens.

A cross-section of the report for the week of June 25th showed that a total of 7639 pheasant eggs had been laid, 2821 birds had been hatched, and there were still incubating on that date, 2354 eggs. Up to this time we had purchased for setting purposes, 408 domestic hens. Most of these hens will be kept over for duty next year.

The report of the same date shows 241 quail eggs laid, 149 birds hatched, and 48 eggs still incubating. The quail had suffered more from the noise than had the pheasants.

The buildings for the attendants at the farm were completed and occupied on June 15th.

During this construction period, the following buildings and pens were completed: Main rearing field consisting of 472 pens of the regulation size of 24 feet square; a breeding section of 48 pens; one domestic poultry house large enough to house 400 hens; one three-room sleeping compartment for men; one four-room cookhouse and mess hall; one storage room and cooking room with facilities for cooking pheasant food; one 3000-gallon tank and tower for domestic water and one 5-room cottage with basement.

Game bird farming is not so very different from any other farming line, only in the product and the equipment used. The work is so well standardized that with the usual amount of care and attention, a well-equipped farm will produce about the same amount of birds in one place as well as in another.

REPORT OF THE BUREAU OF RIVER AND HARBOR POLLUTION.

By Rolin G. Watkins, In Charge.

Appended hereto is a résumé of cases handled by this bureau to date. In this connection it should be noted that, despite the fact that much work has been done on pollution problems by various agencies of the Commission in the past, up to the time of the organization of this bureau on February 1, 1926, there had been no effort to centralize this work with a view to placing the enforcement of *all* the laws relating to pollution of California waters by "materials deleterious to fish, plant or bird life," under one head. The information gathered in the past was in the files of other departments and bureaus, and it was necessary to almost completely pioneer the field of pollution in the establishment of the new bureau. At present it can be said to be "merely scraping the surface." New cases are appearing daily, particularly cases of pollution by oil from oil fields. (Note—Long Beach case is an example of this sort. Serious condition exists there.) It is impossible to investigate all the cases reported to this bureau at once, and we are taking them in the order of their seeming import.

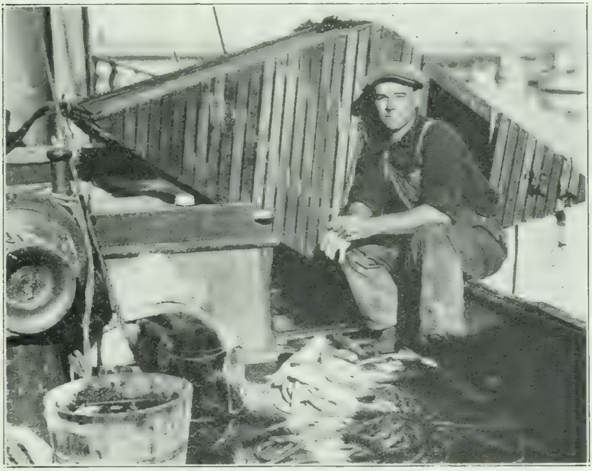


Fig. 17. In order to determine whether pollution is sufficient to kill fish, a live car is often used. In a test made on Dominguez Slough, Long Beach, the fish shown in the picture were killed inside of ten minutes. Photograph by W. L. Woodruff.

The work of this bureau was handled by the director, in conjunction with his duties as director of publicity, until April 1. On this date Robt. J. Irvine, a competent chemist and bacteriologist, was added to the staff. This man will, in future, conduct all routine investigations and handle the laboratory work for the bureau. In addition it is contemplated that his services will be required by the Patrol Department at times to assist in making scientific investigations as to diseases of fish and game and possibly in determining the nature of certain evidences submitted in court cases by the Patrol Service. The larger cases of this bureau, requiring an opinion or ruling on the scene of the pollution, must continue to be handled by the director.

So far this bureau has acted on the assumption that it is best to clean up a condition through seeking the cooperation of those in authority, and we have been forced to file but two suits in court. This condition may, or may not, continue to prevail. In short, it may be but a brief space of time until this bureau may find that particular situation requiring prompt court action, in which event we shall not hesitate. One lesson we have learned: When those in authority at the source of the pollution appear unwilling or unable to get action on conditions complained of, we go to the highest available authorities of the concern, where we usually get the finest cooperation. We are working in conjunction with the Bureau of Sanitary Engineering, State Board of Health, which body has, to date, given splendid cooperation.

The following cases are cited as a cross-section of the work done by this bureau in the first five months of its existence:

Pollution Report to July 1, 1926.

1. Inspection trips.
    A. Oil refineries.
        a. Associated Oil Company. April 7, 1926. Satisfactory.
        b. Shell Oil Company. May 22, 1926. Satisfactory.
        c. Standard Oil Company. May 21, 1926. Satisfactory.
2. Pollution reported and investigated.
    A. Distilleries.
        a. Mason By-Products Company. One fine of $200 in justice court of Sausalito. Numerous attempts to get additional evidence, but not successful as yet.
    B. Gas plants.
        a. Coast Counties Gas and Electric Company, Watsonville. May 28, 1926. Conditions much improved. Complete cleanup when new city sewer is in operation this fall.
        b. Coast Valleys Gas and Electric Company, Monterey. May 10, May 11, May 26, May 27, 1926. Now operating nicely.
        c. Pacific Gas and Electric Company, San Rafael. Extensive improvements being made which will undoubtedly eliminate pollution.
        d. Ukiah. City-owned plant. April 30, 1926. Satisfactory method of handling waste water worked out.
    C. Lumber mills.
        a. Albion Lumber Company, Albion. June 11, 1926. Referred to Screens and Ladders Bureau.
        b. Caspar Lumber Company, Caspar. June 10, 1926. Has cleaned up worst of pollution, but is still under investigation.
        c. Finkbine-Guild Lumber Company, Rockport. June 10, 1926. Referred to Screens and Ladders Bureau.
        d. Greenwood Lumber Company, Greenwood. June 11, 1926. Referred to Screens and Ladders Bureau.
        e. Melville and Sarness Lumber Company, Rockport. June 10, 1926. Satisfactory settlement.

f. Mill Creek Lumber Company, Monterey County. May 27, 1926. In excellent condition.
g. Union Lumber Company, 10-Mile River, Fort Bragg. June 11, 1926. Referred to Screens and Ladders Bureau.

D. Mines.

a. Cloverdale, Sulfur Creek. Mines shut down, but may reopen. Case being watched by Deputy Groves.
b. Westpoint. Shut down; little chance of reopening.

E. Oil.

a. Steamship *Castletown*, Hanlon Ship Yards, Oakland. June 16, 1926. Ship left harbor before court action could be taken. Owners warned.
b. Garages, Napa. April 6, 1926. No action yet.
c. San Luis Obispo (Pismo Beach), Union Oil Company: Fire April 15, 1926. Act of Providence. No action.
d. Santa Fe Yards, Richmond. June 7, 1926. No action yet.
e. Sausalito. April 30, 1926. Reported too late for us to take action.
f. Shell Oil Company Barge *City of Martinez*. May 19, 1926. Act of Providence. No action.
g. Shell Oil Company Steamship *Los Angeles*. Accident. No action.
h. Tiburon, Northwestern Pacific Railroad roundhouse. April 16, 1926. Cleaned up.
i. Union Oil Company, Oleum. Final cleanup started May 14, 1926.
j. Ventura County Oil Fields. (Producing) May 6, 1926. Much improved, but not entirely satisfactory yet.
k. Southern Pacific Company, Yreka. It has been reported that this has been handled satisfactorily.

F. Slaughter houses.

a. Peterson Bros. Inc., Watsonville. Promised to have everything in best shape by November 1, 1926. Making extensive improvements to the whole plant.
b. City Hall Market, Watsonville. May 28, 1926. Now in good shape.
c. San Francisco. International Fish Company, Noyo River. June 10, 1926. Referred to State Bureau of Sanitary Engineering.
d. Columbia and Northern Fishing and Packing Company, Noyo River. June 10, 1926. Referred to State Bureau of Sanitary Engineering.

G. Tanneries.

a. Kullman-Salz Company, Benicia. April 7, 1926. No action.
b. Sawyer Tanning Company, Napa. April 6, 1926. No action.

H. Miscellaneous.

a. Brookdale Lodge. May 26, 1926. Copper sulphate in swimming pool water. This water used by State Fish Hatchery. Cooperation with State Bureau of Sanitary Engineering resulted in amicable settlement of trouble.
b. Cunningham-Thomas Company, Ukiah. April 30, 1926. Lime-sulphur spray dumped into stream. Promised to prevent in the future.
c. Selby Smelting and Lead Company. April 5, 1926. No action; doubtful pollution.
d. Sonoma Valley Hot Springs. May 1, 1926. No action; doubtful pollution.

3. Reported pollution, but not yet investigated.
A. Lumber mills.

a. Little Butte Creek. Deputy to investigate and report.
b. Monterey Bay Lumber Company. This bureau will investigate.

B. Oil.

a. Long Beach. City thinks they can handle matter.

C. Paper mills.

a. Floriston. Will be investigated very soon.

D. Gas plants.

a. Pacific Gas and Electric Company, Sacramento. Will be investigated soon.

E. Mines.

- a. La Grange Dredging Company. Will be investigated soon.
- b. California Zinc Company, Redding. Will be investigated soon.

F. Miscellaneous.

- a. Creamery at Crescent City. Will be investigated soon.
- b. Stevenson Creek, Southern California Edison Company, Big Creek Project. Will be investigated soon.

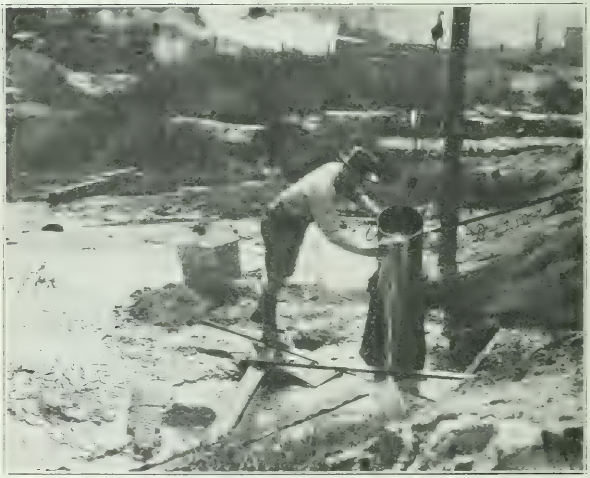


FIG. 18. Securing water sample for chemical test to determine pollution at a sump in Long Beach. Photograph by W. L. Woodruff.

REPORT OF THE BUREAU OF FINANCE AND ACCOUNTS.

H. R. DUNBAR, In Charge.

With the reorganization of the Commission in January, 1926, changes in department administration were effected. As the head office was to be located at San Francisco it was imperative that the license department and accounting department remain at Sacramento, owing to the constant and close business relations with other departments at the State Capitol. Accordingly, a Bureau of Finance and Accounts which included all of the accounting and license distribution and sales of the Commission was created, and H. R. Dunbar, who had been connected with the Commission since 1912 and cashier since November, 1922, placed in charge.

The personnel of the Bureau of Finance and Accounts at the time of its creation was as follows: H. R. Dunbar, cashier and in charge; G. B. Gifford, bookkeeper; Mrs. Othella Coleman, clerk; Miss Eva Pearson, typist-clerk; Mr. L. E. Rust, chief license clerk; Miss Faye Graves, stenographer; Miss Thelma Brietzke, stenographer; J. J. Shannon, license clerk at San Francisco, and Miss S. D. Nash, license clerk at Los Angeles.

On March 26, 1926, Mr. Gifford asked for and was granted a leave of absence and A. A. Manship, who was in the accounting office of the Department of Agriculture, was secured to fill the position.

Immediately after the new bureau was created, the executive officer arranged with the Board of Control to have a thorough audit and examination made of the Commission's accounts and license records. Accordingly, R. R. Soberanes, an accountant of their department, was assigned to make the audit. Mr. Soberanes made a very thorough and exhaustive audit and examination of all the Commission's financial records at Sacramento, San Francisco, Los Angeles and San Pedro. In addition to this Mr. Soberanes revised the system of accounting, thereby eliminating certain unnecessary details, and at all times has been very helpful and congenial.

One of the first steps taken by the new executive officer was the preparation of a budget to cover the expenditures of the Commission for the balance of the seventy-seventh fiscal year. In order to accomplish this the various department and bureau heads were requested to make up budgets for their respective departments. This was immediately done and the full budget was then made up and presented to the Board of Control for their approval.

The work of the Bureau of Finance and Accounts is divided into two functions as follows: In the accounting office all traveling expenses of the employees of the Commission and all of their expense bills pertaining to operation and maintenance of the Commission are thoroughly audited and presented to the Board of Control and Controller's office for their audit and payment. All records and data pertaining to the expenditures of the Commission are kept in this office, being under the direction of the accountant.

The other function of this bureau concerns licenses and revenue. All details pertaining to the printing of licenses and the distribution of the same to the branch offices and various county clerks throughout the state and the collection of all revenue derived from the sale of licenses or from all other sources is done through this office. At the end of each license year, final settlement must be made with the State Controller equal to the value of licenses originally charged. This part of the work is handled under the direction of the cashier. The total value of licenses that the cashier is accountable for to the State Controller at any one time is about $800,000.

In the appendix of the biennial report are shown statements of the expenditures and income of the Commission for the past two years as well as statements showing the sales of the various kinds of licenses.

In addition, the cashier pays through the revolving fund the expense claims of all employees of the Commission immediately after being audited in the accounting office and the revolving fund is reimbursed when the claims have been passed and paid by the State Controller's office. In this way the employees are paid their expenses at least two weeks earlier.

APPENDIX.

STATISTICAL REPORTS.

HUNTING LICENSE SALES—YEAR 1924-1925

Counties	Total sales	Citizen	Non-resident	Alien	Declarant alien
Alameda	$12,928 00	$12,313 00		$225 00	$390 00
Alpine	49 00	29 00	$20 00		
Amador	818 00	788 00	20 00		10 00
Butte	4,688 00	4,638 00			50 00
Calaveras	682 00	682 00			
Colusa	2,194 00	2,154 00	10 00		30 00
Contra Costa	3,201 00	3,036 00		75 00	90 00
Del Norte	968 00	813 00	100 00	25 00	30 00
El Dorado	1,419 00	1,364 00	20 00	25 00	10 00
Fresno	9,345 00	9,160 00	10 00	75 00	100 00
Glenn	1,464 00	1,434 00	10 00		20 00
Humboldt	5,475 00	5,195 00	10 00	100 00	170 00
Imperial	1,445 00	1,420 00		25 00	
Inyo	1,367 00	1,332 00		25 00	10 00
Kern	5,678 00	5,578 00		50 00	50 00
Kings	1,310 00	1,310 00			
Lake	1,603 00	1,583 00	10 00		10 00
Lassen	2,041 00	1,981 00	30 00		30 00
Los Angeles	44,492 00	44,017 00	170 00	175 00	130 00
Madera	1,177 00	1,157 00			20 00
Marin	2,102 00	2,102 00			
Mariposa	168 00	168 00			
Mendocino	3,722 00	3,452 00	10 00		260 00
Merced	2,012 00	2,002 00			10 00
Modoc	3,315 00	1,275 00	2,040 00		
Mono	174 00	154 00	20 00		
Monterey	3,057 00	2,947 00		100 00	10 00
Napa	2,682 00	2,367 00	10 00	75 00	230 00
Nevada	1,126 00	1,051 00	20 00	25 00	30 00
Orange	4,271 00	4,261 00			10 00
Placer	2,758 00	2,448 00		50 00	260 00
Plumas	1,222 00	1,202 00			20 00
Riverside	3,449 00	3,439 00			10 00
Sacramento	9,042 00	8,447 00	60 00	325 00	210 00
San Benito	1,098 00	1,003 00		25 00	70 00
San Bernardino	5,127 00	5,067 00		50 00	10 00
San Diego	8,929 00	8,819 00	20 00	50 00	40 00
San Francisco	19,387 00	14,972 00	70 00	1,825 00	2,520 00
San Joaquin	5,537 00	5,307 00		100 00	130 00
San Luis Obispo	2,688 00	2,573 00		75 00	40 00
San Mateo	2,529 00	2,109 00	20 00	100 00	300 00
Santa Barbara	3,165 00	2,985 00		100 00	80 00
Santa Clara	6,858 00	6,658 00	30 00	50 00	120 00
Santa Cruz	2,900 00	2,520 00		100 00	280 00
Shasta	2,624 00	2,514 00	30 00		80 00
Sierra	303 00	258 00	20 00	25 00	
Siskiyou	7,070 00	4,255 00	2,230 00	125 00	460 00
Solano	3,115 00	2,940 00	100 00	75 00	
Sonoma	7,843 00	7,223 00		200 00	420 00
Stanislaus	3,476 00	3,376 00			100 00
Sutter	906 00	881 00		25 00	
Tehama	1,437 00	1,417 00	20 00		
Trinity	979 00	969 00			10 00
Tulare	4,872 00	4,777 00	10 00	75 00	10 00
Tuolumne	1,344 00	1,279 00		25 00	40 00
Ventura	3,041 00	2,906 00		125 00	10 00
Yolo	2,460 00	2,320 00		50 00	90 00
Yuba	2,177 00	2,072 00		75 00	30 00
Oregon (state of)	4,142 00	102 00	4,040 00		
Nevada (state of)	140 00		140 00		
Total sales	$245,591 00	$224,601 00	$9,300 00	$4,650 00	$7,040 00
Total number of licenses	226,421	224,601	930	186	704

HUNTING LICENSE SALES—YEAR 1925-1926.

Counties	Total sales	Citizen	Non-resident	Alien	Declarant alien
Alameda	$13,304 00	$12,459 00		$275 00	$570 00
Alpine	88 00	48 00	$40 00		
Amador	904 00	824 00		50 00	30 00
Butte	5,094 00	5,034 00			60 00
Calaveras	979 00	979 00			
Colusa	2,284 00	2,239 00		25 00	20 00
Contra Costa	3,236 00	3,076 00		100 00	60 00
Del Norte	940 00	825 00	70 00	25 00	20 00
El Dorado	1,524 00	1,484 00	30 00		10 00
Fresno	9,554 00	9,234 00	40 00	150 00	130 00
Glenn	1,621 00	1,591 00	30 00		
Humboldt	5,169 00	4,964 00	20 00	75 00	110 00
Imperial	1,754 00	1,694 00		50 00	10 00
Inyo	1,607 00	1,572 00	10 00	25 00	
Kern	6,490 00	6,405 00		25 00	60 00
Kings	1,298 00	1,278 00			20 00
Lake	1,977 00	1,977 00			
Lassen	2,439 00	2,269 00	70 00		100 00
Los Angeles	42,852 00	42,187 00	100 00	275 00	290 00
Madera	1,459 00	1,419 00			40 00
Marin	2,011 00	2,011 00			
Mariposa	226 00	226 00			
Mendocino	3,571 00	3,456 00		25 00	90 00
Merced	2,421 00	2,401 00			20 00
Modoc	2,389 00	1,239 00	1,150 00		
Mono	274 00	234 00	40 00		
Monterey	3,291 00	3,106 00		75 00	110 00
Napa	2,680 00	2,410 00		50 00	220 00
Nevada	1,119 00	1,044 00	30 00	25 00	20 00
Orange	4,040 00	4,030 00			10 00
Placer	3,243 00	2,858 00	40 00	75 00	270 00
Plumas	1,642 00	1,592 00	30 00		20 00
Riverside	4,633 00	4,613 00			20 00
Sacramento	8,455 00	7,775 00	50 00	400 00	230 00
San Benito	1,166 00	1,101 00		25 00	40 00
San Bernardino	4,756 00	4,746 00			10 00
San Diego	8,513 00	8,343 00	40 00	100 00	30 00
San Francisco	18,009 00	14,449 00	180 00	1,450 00	1,930 00
San Joaquin	6,287 00	6,002 00		125 00	160 00
San Luis Obispo	2,996 00	2,846 00		100 00	50 00
San Mateo	2,896 00	2,121 00		425 00	350 00
Santa Barbara	3,787 00	3,582 00		125 00	80 00
Santa Clara	7,017 00	6,757 00		150 00	110 00
Santa Cruz	2,985 00	2,640 00		75 00	270 00
Shasta	2,665 00	2,585 00	10 00		70 00
Sierra	337 00	312 00		25 00	
Siskiyou	9,256 00	4,806 00	3,770 00	150 00	530 00
Solano	2,946 00	2,796 00		50 00	100 00
Sonoma	7,539 00	6,874 00	10 00	175 00	480 00
Stanislaus	3,739 00	3,589 00			150 00
Sutter	947 00	947 00			
Tehama	1,938 00	1,893 00		25 00	20 00
Trinity	860 00	860 00			
Tulare	4,988 00	4,908 00		50 00	30 00
Tuolumne	1,108 00	1,088 00			20 00
Ventura	2,977 30	2,822 30	10 00	125 00	20 00
Yolo	2,430 00	2,295 00		25 00	110 00
Yuba	2,089 00	2,069 00			20 00
Oregon (state of)	4,632 00	282 00	4,350 00		
Nevada (state of)	520 00		520 00		
Total sales	$251,951 30	$229,266 30	$10,640 00	$4,925 00	$7,120 00
Total number of licenses	231,239	229,266	1,064	197	712

ANGLING LICENSE SALES—YEAR 1924.

Counties	Total sales	Citizen	Non-resident	Alien
Alameda	$11,391 00	$11,010 00	$6 00	$375 00
Alpine	382 00	106 00	264 00	12 00
Amador	737 00	710 00	24 00	3 00
Butte	4,791 00	4,626 00	30 00	135 00
Calaveras	909 00	885 00		24 00
Colusa	749 00	728 00		21 00
Contra Costa	2,376 00	2,316 00		60 00
Del Norte	969 00	867 00	57 00	45 00
El Dorado	2,092 00	1,992 00	33 00	67 00
Fresno	8,571 00	8,145 00	9 00	417 00
Glenn	689 00	686 00	3 00	
Humboldt	6,626 00	6,404 00	15 00	207 00
Imperial	303 00	303 00		
Inyo	3,870 00	3,735 00	54 00	81 00
Kern	2,253 00	2,232 00	6 00	15 00
Kings	596 00	542 00		54 00
Lake	1,111 00	1,096 00	3 00	12 00
Lassen	1,865 00	1,754 00	30 00	81 00
Los Angeles	37,166 00	36,653 00	159 00	354 00
Madera	1,140 00	1,119 00	3 00	18 00
Marin	1,413 00	1,413 00		
Mariposa	1,485 00	1,404 00	60 00	21 00
Mendocino	2,928 00	2,841 00	9 00	78 00
Merced	1,269 00	1,239 00	9 00	21 00
Modoc	994 00	955 00	33 00	6 00
Mono	845 00	458 00	282 00	105 00
Monterey	1,365 00	1,293 00	12 00	60 00
Napa	1,753 00	1,714 00	3 00	36 00
Nevada	2,260 00	2,068 00	84 00	108 00
Orange	2,460 00	2,448 00		12 00
Placer	2,980 00	2,780 00	33 00	167 00
Plumas	2,475 00	2,301 00	63 00	111 00
Riverside	1,868 00	1,823 00		45 00
Sacramento	11,306 00	8,426 00	36 00	2,844 00
San Benito	234 00	234 00		
San Bernardino	8,971 00	8,896 00	18 00	57 00
San Diego	5,891 00	5,840 00	12 00	39 00
San Francisco	16,940 00	15,536 00	48 00	1,356 00
San Joaquin	7,660 00	6,730 00		930 00
San Luis Obispo	659 00	638 00	6 00	15 00
San Mateo	889 00	889 00		
Santa Barbara	2,635 00	2,584 00		51 00
Santa Clara	3,967 00	3,916 00		51 00
Santa Cruz	2,484 00	2,346 00		138 00
Shasta	3,003 00	2,922 00	6 00	75 00
Sierra	644 00	593 00	30 00	21 00
Siskiyou	6,056 00	5,483 00	303 00	270 00
Solano	2,570 00	2,204 00		366 00
Sonoma	5,588 00	5,426 00	9 00	153 00
Stanislaus	4,996 00	4,867 00	6 00	123 00
Sutter	541 00	517 00		24 00
Tehama	1,446 00	1,431 00	6 00	9 00
Trinity	661 00	649 00		12 00
Tulare	4,059 00	3,927 00	18 00	114 00
Tuolumne	1,391 00	1,355 00	6 00	30 00
Ventura	2,264 00	2,180 00	3 00	81 00
Yolo	807 00	777 00		30 00
Yuba	1,583 00	1,529 00		54 00
Reno, Nevada	1,062 00		1,062 00	
Total sales	$210,988 00	$198,541 00	$2,853 00	$9,594 00
Total number of licenses	202,690	198,541	951	3,198

ANGLING LICENSE SALES—YEAR 1925.

Counties	Total sales	Citizen	Non-resident	Alien
Alameda	$13,690 00	$13,234 00	$12 00	$444 00
Alpine	414 00	120 00	294 00	
Amador	792 00	774 00	3 00	15 00
Butte	4,684 00	4,525 00	21 00	138 00
Calaveras	948 00	933 00	12 00	3 00
Colusa	794 00	761 00	9 00	24 00
Contra Costa	2,652 00	2,565 00		87 00
Del Norte	1,111 00	1,012 00	72 00	27 00
El Dorado	1,899 00	1,788 00	18 00	93 00
Fresno	10,484 00	9,905 00	18 00	561 00
Glenn	663 00	657 00	3 00	3 00
Humboldt	5,824 00	5,638 00	15 00	171 00
Imperial	492 00	480 00	3 00	9 00
Inyo	4,631 00	4,427 00	96 00	108 00
Kern	3,211 00	3,181 00	6 00	24 00
Kings	776 00	764 00		12 00
Lake	1,173 00	1,170 00		3 00
Lassen	2,430 00	2,352 00	24 00	54 00
Los Angeles	39,561 00	38,961 00	147 00	453 00
Madera	1,727 00	1,700 00	3 00	24 00
Marin	1,713 00	1,686 00		27 00
Mariposa	1,411 00	1,387 00	12 00	12 00
Mendocino	2,782 00	2,698 00	6 00	78 00
Merced	1,582 00	1,567 00		15 00
Modoc	896 00	845 00	30 00	21 00
Mono	925 00	547 00	345 00	33 00
Monterey	1,927 00	1,873 00		54 00
Napa	2,211 00	2,160 00	6 00	45 00
Nevada	2,045 00	1,820 00	69 00	156 00
Orange	2,719 00	2,689 00	3 00	27 00
Placer	3,277 00	2,995 00	54 00	228 00
Plumas	2,515 00	2,350 00	78 00	87 00
Riverside	2,447 00	2,387 00	3 00	57 00
Sacramento	12,529 00	9,655 00	24 00	2,850 00
San Benito	366 00	354 00	3 00	9 00
San Bernardino	8,017 00	7,921 00	15 00	81 00
San Diego	6,916 00	6,862 00	21 00	33 00
San Francisco	19,857 00	18,180 00	72 00	1,605 00
San Joaquin	7,071 00	6,333 00	6 00	732 00
San Luis Obispo	995 00	971 00		24 00
San Mateo	1,039 00	1,018 00		21 00
Santa Barbara	2,495 00	2,435 00		60 00
Santa Clara	5,487 00	5,415 00	9 00	63 00
Santa Cruz	2,858 00	2,732 00		126 00
Shasta	2,999 00	2,927 00	21 00	51 00
Sierra	679 00	640 00	18 00	21 00
Siskiyou	6,511 00	5,818 00	420 00	273 00
Solano	2,887 00	2,470 00		417 00
Sonoma	5,748 00	5,610 00	3 00	135 00
Stanislaus	3,976 00	3,916 00	3 00	57 00
Sutter	811 00	778 00	3 00	30 00
Tehama	1,683 00	1,653 00	9 00	21 00
Trinity	519 00	504 00	6 00	9 00
Tulare	5,324 00	5,153 00	60 00	111 00
Tuolumne	1,880 00	1,826 00	15 00	39 00
Ventura	2,569 00	2,500 00	30 00	39 00
Yolo	916 00	889 00		27 00
Yuba	1,840 00	1,705 00	6 00	129 00
Nevada, state of	2,079 00		2,079 00	
Oregon, state of	44 00	8 00	36 00	
Totals	$232,501 00	$218,224 00	$4,221 00	$10,056 00
Total number of licenses	222,983	218,224	1,407	3,352

MARKET FISHERMEN'S LICENSE SALES.

Total sales, license year April 1, 1924, to March 31, 1925	$46,710 00
Total sales, license year April 1 1925, to March 31, 1926	50,720 00

License fee: All persons, $10.

TRAPPING LICENSE SALES.

Total sales, license year July 1, 1924, to June 30, 1925	$2,984 00
Total sales, license year July 1, 1925, to June 30, 1926	3 598 00

License fee: Citizens, $1; aliens, $2.

FISH PACKERS' AND WHOLESALE SHELL-FISH DEALERS' LICENSE SALES.

Total sales, license year July 1, 1924, to June 30, 1925	$1,200 00
Total sales, license year July 1, 1925, to June 30, 1926	1,345 00

License fee: Citizens, $5; aliens, $20.

GAME BREEDERS' LICENSE SALES.

Total sales, license year January 1, 1924, to December 31, 1924	$240 00
Total sales, license year January 1. 1925, to December 31, 1925	320 00

License fee: All persons, $2.50.

FISH BREEDERS' LICENSE SALES.

Total sales, license year January 1, 1924, to December 31, 1924	$65 00
Total sales, license year January 1, 1925, to December 31, 1925	65 00

License fee: All persons, $5.

DOMESTICATED FISH IMPORTERS' LICENSE SALES.

Total sales, license year January 1, 1924, to December 31, 1924	Non
Total sales, license year January 1, 1925, to December 31, 1925	None

License fee: All persons, $5.

KELP LICENSE SALES.

Total sales, year 1924	$10 00
Total sales, year 1925	20 00

License for term of one year from date of issue. Fee, $10.

VIOLATIONS OF FISH AND GAME LAWS.

GAME CASES.

	July 1, 1924, to June 30, 1925			July 1, 1925, to June 30, 1926		
	Number of arrests	Amount of fines and forfeitures imposed	Jail sentences imposed (days)	Number of arrests	Amount of fines and forfeitures imposed	Jail sentences imposed (days)
Violations Hunting License Act	137	$2,503 00	32	146	$2,255 00	10
Ducks—buy or sell; taking and possession closed season; over bag limit	30	565 00	10	48	1,320 00	152
Geese—taking and possession closed season; over bag limit	5	115 00	25	9	200 00	
Mudhens—taking and possession closed season	1	25 00		7	125 00	
Swans—taking and possession (no open season)	6	150 00		4	115 00	
Cranes—taking and possession (no open season)				2	50 00	
Shorebirds—taking and possession (no open season)	15	385 00		18	490 00	
Doves—taking and possession closed season; over bag limit	49	1 150 00	180	21	573 00	
Pigeons, wild—taking and possession (no open season)	13	275 00		6	175 00	30
Quail—taking and possession closed season; over bag limit	42	1,250 00	30	63	2,355 00	
Pheasants—illegal taking or possession	10	525 00		12	875 00	55
Sage hens—taking and possession closed season; over bag limit	9	175 00		1	25 00	
Non-game birds taking and possession	85	2,227 00		37	1,005 00	20
Deer—buy or sell; run with dogs; taking and possession, closed season; failure to retain horns and hide; over bag limit	84	5,140 00	715	118	6,965 00	515
Deer—taking and possession does, fawns, spiked bucks	61	4,470 00	50	45	2,450 00	360
Mountain sheep—taking and possession (no open season)	3	100 00				
Elk—taking and possession (no open season)	3	Pending				
Squirrels, tree—taking and possession (no open season)	8	250 00	30	10	420 00	
Rabbits, cottontail, brush—taking and possession closed season	26	585 00	30	52	1,475 00	30
Fur trapping regulations, violations of	5	90 00		12	190 00	
Beaver hides—illegal possession	2	125 00				
Trespass	11	230 00		10	310 00	
Shoot wild game from automobile, power or sail boat; illegal use of scull boat	3	150 00		29	536 00	2
Game refuge—hunting and possession of firearms	17	625 00		18	350 00	
Night hunting	79	2,035 00	375	60	1,150 00	
Total game cases	704	$23,145 00	1,477	728	$23 409 00	1,174

FISH CASES.

	July 1, 1924, to June 30, 1925			July 1, 1925, to June 30, 1926		
	Number of arrests	Amount of fines and forfeitures imposed	Jail sentences imposed (days)	Number of arrests	Amount of fines and forfeitures imposed	Jail sentences imposed (days)
Violations Angling License Act	66	$1,191 00	11	67	$1,430 00	50
Violations Commercial Fishing License Act	39	580 00		46	580 00	
Trout—taking and possession closed season; other than hook and line; over bag limit; offering for sale	79	1,910 00	25	82	2,625 00	50
Black bass—taking and possession closed season; over bag limit; undersized	7	85 00	40	8	195 00	
Sunfish, perch, crappie—taking and possession closed season	2	45 00		8	110 00	50
Night fishing, illegal	9	190 00	25	8	205 00	
Fishing—within 250 feet of fishway, within 150 feet of lower side of dam	21	450 00	40	18	320 00	540
Striped bass—closed season sale; undersized; over bag limit; shipment out of state	107	3,010 00		86	2,540 00	70
Shad—illegal possession and sale	2	40 00		3	60 00	
Salmon—closed season sale; over bag limit; illegal taking and possession	7	300 00		20	1,275 00	150
Catfish—sale of undersized	1	20 00				
Halibut—undersized	1	25 00		2	40 00	
Barracuda—undersized	8	200 00		6	220 00	
Spot-fin croaker, sale of	1	10 00		1	25 00	
Sturgeon—possession of				1	25 00	
Smelt—young of, possession				1	20 00	
Salt water perch—closed season sale				1	25 00	
Salt water eels—over bag limit; undersized	4	125 00		4	90 00	
Crabs—taking and possession closed season; females; undersized; transporting from District No. 1½	27	635 00	25	34	1,365 00	
Clams—taking and possession closed season; over bag limit; undersized	230	6,810 00	304	151	4 795 00	120
Abalones—taking and possession closed season; taking with diving apparatus; over bag limit; undersized	202	5,715 00	252	181	4,995 00	
Lobsters—taking and possession closed season; over bag limit; undersized	33	1,075 00		33	1,205 00	
Illegal fishing—fish reservation				4	170 00	
Illegal shipment—fish, shellfish	6	225 00	100			
Failure to keep commercial fishing data	1	100 00				
Water pollution; use of explosives to take fish				8	650 00	90
Obstructions in streams; failure to maintain fish screen	9	300 00		5	100 00	
Nets, traps, lines—illegal possession or use	43	3,435 00	500	92	8,360 00	
Total fish cases	905	$26,476 00	1,322	870	$31,425 00	1,120

RECAPITULATION.

	Number of arrests	Fines and forfeitures imposed	Jail sentences (days)
Fish cases, 1924-1925	905	$26,476 00	1,322
Game cases, 1924-1925	704	23,145 00	1,477
Totals, 1924-1925	1,609	$49,621 00	2,799
Fish cases, 1925-1926	870	$31,425 00	1,120
Game cases, 1925-1926	728	23,409 00	1,174
Totals, 1925-1926	1,598	$54 834 00	2,294
Recapitulation—			
1924-1925	1,609	$49,621 00	2,799
1925-1926	1,598	54,834 00	2,294
Totals	3,207	$104,455 00	5,093

TOTAL ARRESTS FOR A PERIOD OF TWENTY-FOUR YEARS.

1902-1904	550
1904-1906	774
1906-1908	1,192
1908-1910	1,771
1910-1912	2,063
1912-1914	1,993
1914-1916	2 087
1916-1918	1,797
1918-1920	1,891
1920-1922	2,258
1922-1924	2,715
1924-1926	3,207

SEIZURES OF FISH, GAME AND ILLEGALLY USED FISHING APPARATUS.

	July 1, 1924, to June 30, 1925	July 1, 1925, to June 30, 1926	Total
Ducks	1,062	1,933	2,995
Geese	40	192	232
Mudhens	4	5	9
Swans	3	5	8
Cranes		1	1
Shorebirds	25	273	298
Doves	177	75	252
Wild pigeons	7	10	17
Quail	90	108	198
Pheasants	9	62	71
Sagehens	61	3	64
Non-game birds	25	56	81
Deer meat	1,596 pounds	3,956 pounds	5,192 pounds
Deer heads	4		4
Deer hides	4	11	15
Mountain sheep heads		1	1
Mountain sheep meat	12 pounds		12 pounds
Elk meat	40 pounds		40 pounds
Squirrels	7	17	24
Rabbits—cottontail brush	15	93	108
Bear meat		10 pounds	10 pounds
Beaver hides	11	1	12
Miscellaneous furs	3	14	17
Trout	924	1,284	2,108
Black bass	31	5	36
Crappie, perch, sunfish	39	65	104
Striped bass	19,841 pounds	2,929 pounds	22,770 pounds
Shad	5	340	345
Salmon	3,310 pounds	13 866 pounds	17,176 pounds
Catfish		204 pounds	204 pounds
Barracuda	3,930 pounds	15,002 pounds	18,932 pounds
Spot fin croaker	60 pounds	132 pounds	192 pounds
Sturgeon	156 pounds		156 pounds
Crabs	2,347	3,649	5,996
Crab meat		327 pounds	327 pounds
Clams	6,347	6,129	12,476
Abalones	3,223	1,158	4,381
Abalone meat		105 pounds	105 pounds
Lobsters	3,521 pounds	766 pounds	4,287 pounds
Miscellaneous fish	12 pounds	100 pounds	112 pounds
Nets	20	18	38
Crawfish traps	126		126

Illegally used fishing apparatus, after condemnation in superior courts, is destroyed or sold by the board in accordance with the law. All wholesome fish and game is donated to charitable and public institutions.

SUMMARY OF FISH DISTRIBUTION, SEASON 1924-1925.

Hatchery	Rainbow	Loch Leven	Steelhead	Eastern Brook	German Brown	Large Lake	Cutthroat
Bear Lake	1,640,000						
Brookdale	150,000		1,295,000				
Clear Creek	1,359,462						
Domingo Springs	1,844,722						
Fall Creek	888,000						
Feather River	1,322,200	255,000		201,300		109,400	
Fort Seward	3,783,620		1,582,700			108,920	160,000
Kaweah	235,000		200,000				
Mount Shasta	7,806,004	10,322,504	442,500	5,935,508	3,614,000	180,000	240,000
Mount Tallac	745,000		85,000			1 305,000	
Mount Whitney	3,556,000	659,000	1,047,000	663,000		110,000	
North Creek	1,600,000						
Rush Creek							
Tahoe	1,157,500					727,500	
Ukiah	346,365		835,400				
Wawona	337,500		439,300				
Totals	26,771,373	11,236,504	5,926,900	6,799,808	3,614,000	2,540,820	400,000

SUMMARY OF FISH DISTRIBUTION, SEASON 1924-1925—Continued.

Hatchery	Black Spotted	Mackinaw	Salmon	Golden	Crappie	Sunfish
Bear Lake						
Brookdale						
Clear Creek						
Domingo Springs						
Fall Creek			7,556,000			
Feather River	198,200					
Fort Seward	200,000		498,150			
Kaweah						
Mount Shasta	100,000	75,000	6,103,000			
Mount Tallac						
Mount Whitney	304,000			838,000		
North Creek						
Rush Creek	520,000					
Tahoe						
Ukiah						
Wawona						
Fish transplantation					60	35
Totals	1,322,200	75,000	14,157,150	838,000	60	35

RECAPITULATION, SEASON 1924-1925.

Trout	59,524,700
Salmon	14,157,150
Grand total	73,681,850

FISH DISTRIBUTION BY COUNTIES, SEASON 1925.

Mount Shasta Hatchery.

County	Rainbow	Loch Leven	Eastern Brook	German Brown	Cutthroat	Large Lake	Salmon	Brown Spotted
Alameda	45,000							
Alpine	15,000	25,000	25,000	104,000				
Amador	110,000	290,000	70,000	100,000				
Butte	224,000	301,000	186,000					
Calaveras	235,000	110,000	25,000	134,000				
Colusa	95,000	70,000	35,000					
Del Norte	45,000		75,000			90,000	40,000	
El Dorado	175,000	420,000	274,000	65,000				
Fresno	310,000	365,000	250,000	75,000				
Glenn	32,000	32,000	27,000					
Kern	225 000	175,000	100,000					
Lake	65,000	130,000		100,000				
Lassen	10,000		8,000					100,000
Madera	85,000	100,000	100,000	50,000				
Marin	20,000	75,000						
Mariposa	110,000	101,000	130,000	100,000				
Modoc	83,000	119,000	50,000					
Mono	60,000							
Monterey	425,000	80,000		25,000				
Napa	85,000	35,000		33,000				
Nevada	302,500	595,000	275,000	190,000				
Placer	192,000	202,000	195,000	5,000				
Plumas	86,000	159,000	106,000					
San Diego				200,000				
San Luis Obispo	60,000	135,000						
San Mateo	75,000		10,000	10,000				
Santa Barbara	30,000	30,000	20,000					
Santa Clara			7 500					
Santa Cruz	20,000		32,000					
Shasta	245,500	250,000	140,000	50,000				
Sierra	10,000	35,000	20,000					
Siskiyou	540,000	569,000	517,500	140,000	100,000		3,042,000	
Solano		100,000						
Sonoma		5,000						
Tehama	157,000	118,000	8,000	22,000				
Trinity	195,000	180,000	120,000					
Tuolumne	255,000	549,000	195,000	362,000				
Yolo				15,000				
Totals	4,622,000	5.355,000	3,001,000	1,780.000	100,000	90,000	3,082,000	100,000

Fall Creek Hatchery.

County	Rainbow	Salmon
Siskiyou	635,000	5,249,000

Mount Whitney Hatchery.

County	Rainbow	Loch Leven	Steelhead	Eastern Brook	Brown Spotted	Golden
Fresno	100 000		50,000			
Inyo	444,000	222,000	170,000	136,000	36,000	120,000
Los Angeles	286,500	12.500	30,000			
Mono	921,000	35,000	140,000	152,000	268,000	306.000
Riverside	157,000	10,000	15,000	51,000		
San Bernardino	70,000					
San Diego	117,500		120 000			
Tulare	446,000	25,000	20,000	10.000		
Ventura	147,500	7,500	180,000	2,000		
Totals	2,689,500	312,000	725 000	351,000	304,000	426,000

Rush Creek Hatchery.

County—	Black Spotted
Mono	520,000

Fort Seward Hatchery.

County	Rainbow	Steelhead	Black Spotted	Salmon	Cutthroat
Humboldt	2,246,260	943,610	200,000	249,780	10,000
Mendocino	540,000	265,000			
Trinity	100,000				
Totals	2,886,260	1,208,610	200,000	249,780	10,000

Ukiah Hatchery.

County	Rainbow	Steelhead
Lake	30,000	100,000
Mendocino	39,500	331,000
Sonoma	80,000	280,000
Totals	149,500	711,000

Tahoe Hatchery.

County	Rainbow	Large Lake
El Dorado	265,000	25,000
Nevada	65,000	
Placer	600,000	160,000
Sierra	40,000	20,000
Totals	970,000	205,000

Tallac Hatchery.

County	Rainbow	Steelhead	Large Lake
Alpine	45,000		20,000
El Dorado	700,000	85,000	295,000
Totals	745,000	85,000	315,000

Domingo Springs Hatchery

County—	Rainbow
Lassen	235,000
Plumas	270,627
Total	505,627

Clear Creek Hatchery

County—	Rainbow
Lassen	594,942
Plumas	78,000
Shasta	10,000
Total	682,942

Bear Lake Hatchery

County—	Rainbow
San Bernardino	1,040,000

North Creek Hatchery.

County—	Rainbow
San Bernardino	1,000,000

Brookdale Hatchery.

County	Rainbow	Steelhead
Santa Clara	75,000	75,000
Tulare		100,000
Santa Cruz	75,000	520,000
Totals	150,000	695,000

Feather River Hatchery.

County	Rainbow	Loch Leven	Eastern Brook	Black Spotted
Butte	14,000		6,000	
Plumas	406,400	130,000	126,300	128,200
Sierra	285,000	80,000	30,000	70,000
Yuba	56,000	45,000	39,000	
Totals	761,400	255,000	201,300	198,200

Wawona Hatchery.

County	Rainbow	Steelhead
Mariposa	238,000	239,000

Kaweah Hatchery.

County	Rainbow	Steelhead
Tulare	75,000	20,000

FISH DISTRIBUTION BY COUNTIES, SEASON 1924.

Mount Shasta Hatchery.

County	Rainbow	Loch Leven	Steelhead	Eastern Brook	German Brown	Cutthroat	Large Lake	Salmon	Mackinaw
Alpine	10,000	59,000	4,000		70,000				
Amador	70,000	220,000	30,000	75,000	175,000				
[illegible]	145,000	155,000	10,000	150,000					
[illegible]	140,000	206,000	6,000	38,000	200,000				
Colusa	55,000	60,000	25,000	30,000					
[illegible]	40,000			76,000			90,000	40,000	
El Dorado	150,000	470,000	50,000	235,000	8,000				
[illegible]	250,000	445,000	20,000	286,500	150,000				
[illegible]	180,000	150,000		50,000					
Lake	35,000	100,000	15,000		100,000				75,000
[illegible]					10,000				
Madera	65,000	125,000		110,000					
[illegible]	10,000	60,000	10,000						
[illegible]	86,000	180,000		100,000	54,000				
Modoc	43,000	100,500	2,500	82,500					
Mono	25,000	100,000	20,000	40,000					
[illegible]	200,000								
Napa	30,000	115,000	70,000						
Nevada	250,000	665,000	75,000	463,500	260,000				
[illegible]	87 500	152,500	10,000	183,000					
[illegible]	135,000	280,500		190,500					
[illegible]	4	4		8					
[illegible]					490,000				
[illegible]	15,000		30,000						
[illegible]	20,000	30,000	10,000	20,000					
Shasta	256,000	190,000	5,000	125,000	50,000				
[illegible]		37,000		84,500					
[illegible]	330,000	497,000	50,000	310,000	105,000	140,000		2,981,000	
[illegible]		4,000							
[illegible]	127,000	50,000			12,000				
[illegible]	195,000	50,000		15,000					
Tulare		100,000							
[illegible]	209,500	341,000		270,000	150,000				
Yuba	25,000	25,000							
Totals	3,184,004	4,967,504	442,500	2,934,508	1,834,000	140,000	90,000	3,021,000	75,000

Fall Creek Hatchery.

County	Rainbow	Salmon
[illegible]	253,000	2,307,000

Mount Whitney Hatchery.

County	Rainbow	Loch Leven	Steelhead	Eastern Brook	Golden	Large Lake
Fresno					332,000	
[illegible]	213,000	92,000	32,000	71,000	12,000	30,000
[illegible]	132,750		19,000			
Mono	161,000	150,000	20,000	201,000	68,000	80,000
[illegible]	53,750	50,000	20,000	10,000		
[illegible]	120,000	10,000	85,000			
[illegible]	80,000	45,000	30,000	20,000		
[illegible]	106,000		116,000	10,000		
Totals	866,500	347,000	322,000	312,000	412,000	110,000

Fort Seward Hatchery.

County	Rainbow	Steelhead	Large Lake	Cutthroat	Salmon
Humboldt	768,360	264,090	108,920	150,000	198,370
Mendocino	129,000	110,000			50,000
Totals	897,360	374,090	108,920	150,000	248,370

Ukiah Hatchery.

County	Rainbow	Steelhead
Lake	20,000	50,000
Mendocino	86,865	34,400
Sonoma	90,000	40,000
Totals	196,865	124,400

Tallac Hatchery.

County—	Large Lake
El Dorado	990,000

Tahoe Hatchery.

County	Rainbow	Large Lake
Alpine	20,000	
El Dorado	42,500	150,000
Nevada	25,000	37,500
Placer	100,000	310,000
Sierra		25,000
Totals	187,500	522,500

Domingo Springs Hatchery.

County—	Rainbow
Lassen	1,163,095
Plumas	176,000
Total	1,339,095

Clear Creek Hatchery.

County—	Rainbow
Lassen	56,000
Plumas	620,520
Total	676,520

Bear Lake Hatchery.

County—	Rainbow
San Bernardino	600,000

North Creek Station.

County—	Rainbow
San Bernardino	600,000

Brookdale Hatchery.

County—	Steelhead
San Mateo	59,000
Santa Clara	50,000
Santa Cruz	500,000
Totals	600,000

Feather River Hatchery.

County	Rainbow	Large Lake
Plumas	245,800	44,400
Shasta	20,000	
Sierra	295,000	65,000
Totals	560,800	109,400

Wawona Hatchery.

County	Rainbow	Steelhead
Mariposa	99,500	200,300

Kaweah Hatchery.

County	Rainbow	Steelhead
Tulare	160,000	180,000

Fish Transplantation

County	Crappie	Sunfish
Tuolumne	60	35

LION BOUNTIES.

Statement of lion bounties paid by the Fish and Game Commission.

County	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	Total
Alameda		1															1			2
Alpine									1									1	1	3
Amador		3		1	2	2										2			1	12
Butte	2	11	5	2	4	3	2	1			1		2			1			1	35
Calaveras		1	4	1		1		1	3				2		3		1	2	1	20
Colusa		3		3	3	1	1	2	1			3			1	2	1	2	2	25
Del Norte		10	12	4	11	11	23	4	2	9	4	2	5	1	3	4	2	8	6	121
El Dorado	2	7	2	1	8	9	6	1		2	1	1	8	6	14	7	3	3	4	85
Fresno		1	3	1		4		1	1	1	4	3	4	2	6	2	3	10	2	48
Glenn		13	6	6	1	4	5	1			1	3	3	3	3	10	1	4	1	65
Humboldt	10	113	67	71	42	50	41	46	26	39	29	22	8	19	16	14	10	11	13	647
Imperial									1					1						2
Inyo						1		1	3	1			1		1		4	4		16
Kern		8	10	12	5	9	10	5	15	18	17	10	15	12	8	17	22	21	14	228
Kings											1									1
Lake	2	14	11	13	9	10	7	5	8	2	5	11	9	11	10	21	21	12	17	198
Lassen			1		2	1	2						1		2					9
Los Angeles		7	1	2	2		2	5	5	1	7	8	9	12	7	5	3	4	3	83
Madera		3	5	1		1	1	9	10	1	2	5	1	1			1	2	2	45
Mariposa	2	4	3	6	2	1	4	9	2	14	13	12	5	4	6	7	5			99
Mendocino	5	44	18	11	16	17	24	15	7	7	15	18	22	13	15	22	9	15	30	323
Merced				1										1	1				1	4
Modoc			1	1	1							1						1		5
Mono								2		5				1	2	1		1	2	14
Monterey		14	11	7	1	3	9	3	8	6	12	12	19	12	7	16	17	30	23	210
Napa				1		2														3
Nevada		1	1	1						2		2						1		8
Orange			1	1	1		1				2	2	1							9
Placer		5	4	1	2	7	3	3	1	4	2	2	3	9	13		5			64
Plumas		2		3		1	2				1					1				10
Riverside		2	5			4	2			3	4	4	5	6	8		2	2	3	50
Sacramento													1							1
San Benito		1	2	1	2	11	3	2	2	5	1	2	1	2	2	2	3	2	1	45
San Bernardino		5	2	1	2		2	1	1		1	5	3	6	2	4	3	4	10	52
San Diego		3	5	5	8	3	1	2	1	1	3	4	5	4	2		1	5	5	58
San Joaquin									2											2
San Luis Obispo		11	5	9	4	4	5	7	10	3	9	3	6	9	12	13	10	8	5	133
San Mateo				1																1
Santa Barbara		7	24	7	3	5	11	4	4	6	3	6	19	5	15	26	13	11	5	174
Santa Clara			4			1	1	1	1	4	2	3	2	2	4	1	11	4	3	44
Santa Cruz				1									1				2			4
Shasta	1	25	32	31	29	28	22	9	7	10	11	26	30	8	8	37	16	16	17	363
Sierra		1				3	2													6
Siskiyou	1	31	35	45	25	25	22	31	9	9	7	1		2	9	14	5	6	3	280
Sonoma			2	4	1	4	1	2		1	4	2	1	2		1				25
Stanislaus			2		1				1		3	1	1		1				3	13
Sutter						1							1							2
Tehama	3	31	19	25	10	22	27	5	4	1	3	6	3	17	18	14	4	14	2	228
Trinity	9	86	34	32	22	15	14	13	4	3	2	12	14	13	21	19	11	16	15	355
Tulare		6	8	11	4	5	3	10	8	8	4	11	17	23	17	22	15	45	9	226
Tuolumne		6	10	5	2	4	1	2	7	11	6	9	12	4	15	13	11	4	1	123
Ventura		1	6	4	6	2		1	7	1	8	2	2	8	4	1	8	15	15	91
Yuba		1			2								1				1	1	4	10
Totals	37	482	361	333	233	275	260	204	162	179	188	214	243	219	256	299	225	285	225	4,680
Male lions, per cent												52	58	52	52	46	52	47	48	51
Female lions, per cent												48	42	48	48	54	48	53	52	49

REPORT ON CATCH OF FUR-BEARING MAMMALS.

Summary Data Furnished by 1,933 Trappers of a Total of 2,984 to Whom Trapping Licenses were Issued for the Season of 1924-1925.

Species	Number	Price average	Estimated value
Skunk	18,811	$1.265	$23,795 91
Raccoon	7,132	3.28	23,392 96
Gray Fox	5,379	1.852	9,961 91
Coyote	5,212	4.412	22,995 34
Wild Cat	3,527	2.24	7,900 48
Civet Cat	2,180	.476	1,037 68
Muskrat	2,022	.463	936 19
Mink	1,987	4.635	9,209 75
Ringtail Cat	1,493	2.018	3,012 87
Kit Fox	817	1.949	1,592 33
Marten	704	10.677	7,516 16
Badger	296	1.578	467 09
Opossum	231	.634	146 45
Weasel	219	.792	173 45
Bear	147	8.50	1,249 50
River Otter	92	12.26	1,127 92
Fisher	44	36.784	1,618 50
Mountain Lion	42	15.80	663 60
Red Fox	29	18.583	538 90
Wolverine	2	10.00	20 00
Totals	50,336	....	$117,356 99

ESTIMATED VALUE OF CALIFORNIA PELTS, 1924-1925.

Species	Estimated number	Average price per skin	Estimated value
Skunk	29,092	$1.265	$36,721 65
Raccoon	11,006	3.28	36,099 88
Gray Fox	8,301	1.852	15,373 45
Coyote	8,043	4.412	35,485 72
Wild Cat	5,443	2.24	12,192 32
Civet Cat	3,364	.476	1,601 26
Muskrat	3,120	.463	1,444 56
Mink	3,066	4.635	14,310 91
Ringtail Cat	2,304	2.018	4,649 47
Kit Fox	1,261	1.949	2,457 69
Marten	1,086	10.677	11,599 70
Badger	457	1.578	720 15
Opossum	356	.634	225 70
Weasel	338	.792	267 70
Bear	227	8.50	1,929 50
River Otter	142	12.26	1,740 92
Fisher	68	36.784	2,501 31
Mountain Lion	65	15.80	1,027 00
Red Fox	45	18.583	836 24
Wolverine	3	10.00	30 00
Totals	77,724	....	$181,115 13

The above is an estimate based on reports furnished by 64.8 per cent of the trappers to whom licenses were issued for the season 1924-1925.

Number of trapping licenses issued, 1924-1925 2,984
Number of trappers reporting 1,933

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1924.

(Compiled by the Department of Commercial Fisheries, Fish and Game Commission of California.)

Canned.

Species of fish	Size of cans	Northern California district	Monterey district	San Pedro district	San Diego district	Total
		Cases	*Cases*	*Cases*	*Cases*	*Cases*
[illegible]	1-lb.		2,928			2,928
[illegible]	1-lb.			35,286	15,847	51,133
	½-lb.			211,440	79,299	290,739
	¼-lb.			32,088	11,812	43,900
Albacore flake	1-lb.			41		41
Bonita	1-lb.			25		25
	[illegible]			4,764	327	5,091
	¼-lb.			7,231		7,231
[illegible]	[illegible]			30,109		30,109
[illegible]	1-lb. oval			5,229		5,229
[illegible]	1-lb. flat	4,456				4,456
	½-lb. flat	11,788				11,788
[illegible]	1-lb. oval		631,286	693,133	12,135	1,336,554
	1-lb. tall		488			488
	½-lb. oval		16,162		523	16,685
	[illegible]		466	515	2,359	3,340
	[illegible]		5,788	3,976	53,297	63,061
[illegible]	¼-lb.			17,864		17,864
[illegible]	1-lb. tall	1,248				1,248
[illegible]	½-lb. oval	885				885
[illegible]	½-lb.		3,995			3,995
[illegible]	1-lb. flat	251				251
	½-lb. flat	1,281				1,281
[illegible]	1-lb.			2,697	456	3,153
	½-lb			28,671	6,916	35,587
	¼-lb.			12,833	1,394	14,227
[illegible]	[illegible]			6,433		6,433
	1-lb			62		62
	½-lb			31,401	982	32,383
	¼-lb			22,155	8,005	30,160
Tuna, bluefin	1-lb.			1,807	30	1,837
	½-lb.			14,904	21	14,925
	¼-lb.			6,180	61	6,241
[illegible]	1-lb.			2,630	1,401	4,031
	½-lb.			31,250	4,922	36,172
	¼-lb.			16,170	507	16,677
[illegible]	1-lb			1,686		1,686
	½-lb.			9,368		9,368
	¼-lb			725		725
[illegible]	1-lb.			802	420	1,222
	½-lb.			4,763	2,092	6,855
Yellowtail	1-lb.			2,180	784	2,964
	½-lb.			8,940	1,284	10,224
	¼-lb.			101		101
Totals		19,909	661,113	1,247,459	204,874	2,133,355

Salted, Smoked and Dried, 1924.

Species of fish	Size or quantity	Northern California district	Monterey Bay district	San Pedro district	San Diego district	Total
Barracuda (dried)	Pounds				42,952	42,952
Bonita (salted)	Pounds			22,407		22.407
(dried)	Pounds				14,450	14,450
Mackerel (salted)	200-lb. barrel			95		95
(dried)	Pounds				1,495	1,495
Sablefish (smoked)	Pounds	288,842				288,842
Salacchini	50-lb. boxes		12,000	9,985		21,985
	20-lb. tins		4,000			4,000
	10-lb. boxes		1,500			1,500
Salmon (mild cured)	Tierces	3,910				3,910
(smoked)	Pounds	152,393				152,393
(hard salted)	200-lb. barrel	35				35
Sardines (mild cured)	800-lb. tierces			625		625
(hard salted)	Pounds			12,500	9,000	21,500
Sea bass, black (dried)	Pounds				31,901	31,901
Sea bass, white (dried)	Pounds				3,885	3,885
Shad (mild cured)	Tierces	162				162
Squid (dried)	Pounds		1,113,054			1,113,054
Tuna (dried)	Pounds				3,216	3,216
Yellowtail (hard salted)	Pounds			4,772		4,772
(dried)	Pounds				111,716	111,716
Mixed fish (dried)	Pounds	136,996				136,996
Miscellaneous Data.						
Fish flour, Tons			236			236
Fish meal, Tons		556	6,045	7,726	1,001	15,328
Fish oil, Gallons		24,949	1,215,347	1,059,001	51,425	2,350,722
Estimated value of pack		$1,168,606	$3,296,815	$8,454,380	$2,066,065	$14,985,866
Number of employees		624	1,099	2,271	1,201	5,195
Number of plants operated		28	15	20	9	72
Value of packing plants		$1,058,084	$1,453,033	$3,664,407	$1,421,623	$7,597,147

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1925.

(Compiled by the Department of Commercial Fisheries, Fish and Game Commission of California.)

Canned.

Species of fish	Size of cans	Northern California district	Monterey district	San Pedro district	San Diego district	Total
		Cases	*Cases*	*Cases*	*Cases*	*Cases*
Abalone	1-lb.		2,954			2,954
Albacore	1-lb.			43,709	10,984	54,693
	½-lb.			277,331	77,126	354,457
	¼-lb.			37,900	6,863	44,763
Albacore flake	1-lb.				13	13
	½-lb.				21	21
Bonita	1-lb.			79		79
	½-lb.			5,791	570	6,361
	¼-lb.			2,248		2,248
Fish cakes	1-lb. tall			38,682		38,682
Salmon, chinook	1-lb. flat	4,427				4,427
	½-lb. flat	15,304				15,304
	½-lb. tall	4,512				4,512
Salmon, silver	½-lb. tall	416				416
Sardines	1-lb. oval		737,743	920,191	29,846	1,687,780
	½-lb. oval		29,224		185	29,409
	½-lb. square		1,899	482	3,354	5,735
	½-lb. tall			2,203		2,203
	¼-lb. square		5,996		22,656	28,652
Shad	1-lb. tall	6,564				6,564
Shad roe	½-lb. oval	2,160				2,160
Squid	½-lb.		17,949			17,949
Tonno	4-lb.			315		315
	½-lb.			33,010	1,597	34,607
	¼-lb.			26,115	207	26,322
	¼-lb. (100 to case)				7,842	7,842
Tuna, bluefin	1-lb.			2,719		2,719
	½-lb.			38,307	141	38,448
	¼-lb.			4,721		4,721
Tuna, flakes	1-lb.			1,029		1,029
	½-lb.			9,456	82	9,538
Tuna, striped	1-lb.			8,563	5,682	14,245
	½-lb.			92,875	46,673	139,548
	¼-lb.			27,995	37,620	65,615
	¼-lb. (100 to case)				338	338
Tuna, unclassified	1-lb.			5,060	1,334	6,394
	½-lb.			33,097	14,040	47,137
	¼-lb.			3,714	2,424	6,138
Tuna, yellowfin	1-lb.			4,298	8,897	13,195
	½-lb.			70,150	58,904	129,054
	¼-lb.			21,438	11,774	33,212
Yellowtail	1-lb.			1,379	204	1,583
	½-lb.			8,530	1,516	10,046
Totals		33,383	795,765	1,721,387	350,893	2,901,428

Salted, Smoked and Dried, 1925.

Species of fish	Size or quantity	Northern California district	Monterey Bay district	San Pedro district	San Diego district	Total
Bloaters	50 count box	2,385				2,385
Mackerel (hard salted)	Pounds			693		693
Sablefish (smoked)	Pounds	179,740				179.740
Salacchini	50-lb. boxes		4,978			4,978
	20-lb. tins		408			408
	10-lb. boxes		1,345			1,345
Salmon (mild cured)	Tierces	3,204	139			3.343
(smoked)	Pounds	2,500				2,500
Sardines (soused)	½-lb. jars (24 to case)		800			800
(salted)	Barrels		10			10
Shad (mild cured)	Tierces	194				194
Shrimps (dried)	Pounds	34,515				34,515
Squid (dried)	Tons		238			238
Mixed fish (dried)	Pounds	143,869			121,532	265,401
(hard salted)	Pounds				84,655	84,655
Miscellaneous Data.						
Fish flour, Tons			258			258
Fish meal, Tons		690	6,415	13,023	2,808	22,936
Fish oil, Gallons		27,568	1,218,993	1,715,633	187,847	3.150,041
Estimated value of pack		$1,013,646	$4,216,167	$11,486,659	$2,743,960	$19,460,432
Number of employees		526	1,344	2,657	1,288	5,815
Value of packing plants		$1,291,690	$1,709,633	$4,223,232	$1,439,814	$8,664,369
Number of plants		31	15	19	10	75

CALIFORNIA FRESH FISHERY PRODUCTS FOR YEAR 1924.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego, Imperial	Total	Mexican, brought into California via San Pedro	Mexican, brought into California via San Diego	Total Mexican brought into California
Albacore									420	138	12,140,265	30,232	1,809,291	17,280,316	217,537	197,479	415,016
Anchovies							10,718		297,000	3,400	35,833			346,951		495,605	495,605
Barracuda			3				481		138	59,908	3,587,840	45,080	1,040,317	4,733,779	1,899,139		1,899,139
Bluefish								1,127	24,886	82				26,095			
Boccaccio	10						53,324	113,527	426,536	1,615				595,012			
Bonito	----							146	20	3,786	719,565	1,530	111,135	836,182	133,671	68,516	202,187
Carp	----	1,368		2,543	15,769	52,405	880							79,565			
Catfish	----	62,096		2,756	185,716	101,362								351,960			
Chilipepper	----						57,472	16,818	8,138					82,428			
Cultus Cod	18,981	10,822				198	233,668	23,925	112,838					400,432			
Eels													56	56			
Flounders	13,730	130	12	3,690		9,593	315,567	33,977	675	3	2,069		50	379,496		274	274
Grayfish				------		2,416	91,190	6,900	824		705		290,599	392,634			
Hake				------			58,405	2,375						60,780			
Halibut	113,020	13,380	31	------		------	6,206	988	9,581	423,983	747,798	92,576	252,852	1,660,415	187,440	861,043	1,048,483
Hardhead				------	19,023	......								19,023			
Herring	2,593		5,973	------	----	62,950	351,303	530	900	202			11,169	435,620			
Kingfish	----				----		2,513	9,353	69,057		204,494	56	8,454	383,927	215	175	390
Mackerel	----				----		22	30,496	685,274	20,364	1,951,784	201,967	331,393	3,227,300	5,074	8,160	13,234
Mullet	----				----							240	21,256	21,496	3,590	33,885	37,475
Perch	42,900	875	36,567		---	599	80,034	8,662	16,715	635	89,529	309	12,144	288,969	9,143	7,614	16,757
Pike		---		173	607	4,115	58							4,953		630	630
Pompano		---							72		12,650		337	13,059	770	3,750	4,520
Rock Bass		---								2,323	193,075	27,255	157,967	380,620	20,862	61,726	85,588
Rockfish	13,716	6,751	1,432		...		139,220	123,848	314,755	25,140	1,610,403	36,987	1,434,373	4,003,625	8,892	23,833	32,725
Sablefish	21,100	...					353,116	555,642	3,015	107				933,310			
Salmon	2,193,688	687,240	590	199,988	174,638	1,665,486	3,616,155	372,231	504,955		----			10,015,269			
Sanddabs		11,830					1,638,402	10,287	2,072		7,111	130		1,669,832			
Sardines		125	315				1,090,382	285	117,528,599	615	116,955,284	1,480	7,108,813	242,685,958			
Sculpin											78,808	526	29,736	109,070			
Sea Bass—Black										1,911	23,704	11,967	51,095	88,677	12,221	130,506	142,727
Sea Bass—White	...	1,117	19,846				14,661	14,271	2,979	116,200	619,158	7,978	140,719	936,929	123,245	418,984	542,229
Sea Trout							----						1,731	1,731		8,600	8,600
Shad	...			1,048	3,696	20,541	11,236				482			37,003	.....		....
Shad—Buck				61,533	19,318	521,890								602,741			
Shad—Roe				98,762	36,248	764,158	5							899,473			...

Sheepshead										558	11,613	241	11,015	23,427		840	840
Skates							121,627	2,075			7,435			131,137			
Skipjack								6,883	30		1,252,318		97,195	1,356,426	1,628,932	795,613	2,424,545
Smelt	28,076	7,976	31,489			579	124,287	93,541	74,487	30,914	225,945	78,514	19,472	715,280	2,818	3,814	6,632
Sole	7,116	134,110	28				8,279,015	174,851	90,747	82,764	40,968	5,634	13,147	8,828,380	1,910	5,061	6,971
Splittail					3,210	461								3,671			
Striped Bass		33	2,157	46,133	100,138	443,655	68,318		1,343					661,777			
Suckers		1,788			297									2,085			
Swordfish											17,808		14,025	31,833			
Tomcod						20	34,017	8,487						42,524			
Trout—Steelhead	87,088													87,088			
Tuna											485,267	134		485,401	61,137		61,137
Tuna—Bluefin											3,201,703		39,407	3,241,110			
Tuna—Yellowfin											537,221		143,538	680,759	1,777,167	605,472	2,382,639
Turbot				1,868										1,868			
Whitebait	56,085	172	3,715				62,096	210	205					122,483			
Whitefish										160	189,186		61,317	250,663	2,882	19,532	22,414
Yellowtail										124	1,224,566	1,672	1,636,650	2,863,012	1,142,992	708,145	1,851,137
Miscellaneous	3,784	35,800		208	31	1,985	60,345	2,798	59,320	19,271	127,936	7,347	20,208	339,033	5,133	4,322	9,455
Total fish	2,601,887	978,613	104,056	716,832	858,721	3,652,713	17,175,356	1,644,233	120,232,581	797,233	146,695,532	554,855	17,872,461	313,885,073	7,244,770	4,466,579	11,711,349
Crustaceans:																	
Crabs	[1]167,112	[2]3,864	[3]1,128			[6]1,392	[7]1,283,016	[9]29,208	[10]21,096					[11]1,506,816			
Shrimps			895,919				655,167							1,551,086			
Spiny Lobsters										52,905	118,371	16,665	106,415	294,356	1,381	731,575	732,956
Mollusks:																	
Abalones									2,233,665	8,147				2,241,812	5,000		5,000
Clams—Cockle		924	4,332								1,085			6,341			
Clams—Mixed	12,160	2,686	33,574					150			120	622	67	49,379			
Clams—Pismo									35	293,114				293,149			
Clams—Softshell		2,574	82,104			111,031	47,615							243,324			
Cuttlefish	31		83				7,717	63,104	95,207	50	74		25	166,291			
Mussels						229	7,153		8,545	671		32,625		49,223			
Oysters—Eastern			[4]324,458				[8]202,317							[12]526,775			
Squid									6,779,857		51,172			6,831,029			
Miscellaneous:																	
Terrapins					[5]312									[5]312			
Turtles										51				51			
Totals	2,781,190	988,661	1,445,654	716,832	859,033	3,765,365	19,378,341	1,736,695	129,370,986	1,152,171	146,866,354	604,767	17,978,968	327,645,017	7,251,151	5,198,154	12,449,305

All amounts shown in pounds unless otherwise specified.

[1] 6,963 dozen.
[2] 161 dozen.
[3] 47 dozen.
[4] 1,474,812 shell oysters.
[5] 13 dozen.
[6] 58 dozen.
[7] 53,459 dozen.
[8] 919,625 shell oysters.
[9] 1,217 dozen.
[10] 879 dozen.
[11] 62,784 dozen.
[12] 2,394,437 shell oysters.

CALIFORNIA FRESH FISHERY PRODUCTS FOR YEAR 1925.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego, Imperial	Total	Mexican, brought into California via San Pedro	Mexican, brought into California via San Diego	Total Mexican brought into California
bacore							20,525	51,575	387,729	4,000	16,718,423	37,594	1,465,096	21,684,912	512,718	9,233	521,981
chovies							26,012		1,400		65,659	30,848		123,919			
rracuda										92,523	5,062,184		790,898	5,945,605	1,631,427	428,569	2,059,996
uefish								3,632	31,479					35,111			
ccaccio	10	67					50,817	210,834	468,109	2,104				731,941			
nito							13	1,538	1,187	6,666	618,531	3,868	135,129	770,232	77,675	18,623	96,298
rp		29,652		1,853	29,588	30,936	2,651						255	91,935			
tfish		163,239		1,511	143,419	58,110								366,279			
ilipepper							32,758	124,545	21,342					178,645			
lltus Cod	18,322	30,843					426,571	59,432	145,430		2,347	185		683,130			
ls							130			116				246			
unders	12,013	35,790	157	3,353		3,411	431,596	106,337	178		966	276	40	594,120			
ayfish							196,131	850	20		8,675	317	166,339	372,332			
ke							16,892	5,125						22,017			
libut	106,307	44,955	2,917				7,923	2,625	6,136	326,150	690,195	71,163	255,187	1,513,558	168,972	931,331	1,100,303
rdhead		431			23,137	460								24,028			
rring	3,222		3,878				843,193	2,125	11	1,180			9,065	862,974		2,800	2,800
ngfish							3,888	30,215	73,617		417,351	2,027	9,506	536,604		50	50
ckerel	100						446	4,324	841,440	25,005	1,799,456	250,307	585,025	3,506,103	3,869	12,447	16,316
llet											6,419		15,232	21,651		15,156	15,156
rch	38,504	2,509	47,797				41,412	10,473	21,782	2,100	95,494	2,692	5,710	268,473	1,478	2,400	3,878
ke				28	3,265	2,471								5,764			
mpano									60		8,974		77	9,111		1,425	1,425
ck Bass										61	108,059	13,956	187,985	310,061	3,676	16,548	20,224
ckfish	37,748	28,589					663,616	150,978	215,110	51,319	1,812,106	23,858	1,555,784	4,539,108	326	3,490	3,816
lefish	11,275						418,442	289,502	2,427	3	823			722,472			
mon	3,795,062	582,194	18	185,420	503,731	1,789,695	1,270,918	244,673	851,042					9,525,753			
dabs		25,550					1,643,353	269,844	3,230	180	10,256	434		1,952,847			
rdines			290				463,892		121,756,314	413	174,403,208	1,705	15,669,164	315,294,986			
lpin							125	52	3,175	63	196,407	3,925	22,709	226,456			
Bass—Black										1,433	23,282	17,773	60,416	102,904	4,696	81,472	86,168
Bass—White		29	9,067				46,989	5,347	1,228	81,584	563,770	16,027	163,615	887,656	370,254	603,509	973,763
Trout							75				1,367		1,414	2,856		20,909	20,909
ad				1,888	4,655	20,418	46,317				285			73,563			
ad—Buck				131,029	37,792	788,741	515							958,077			
ad—Roe				191,860	45,648	1,167,052	3,526							1,408,086			

Sheepshead										5,404	23,212	234	18,898	47,748	70	993	1,063
Skates		650					156,328	17,452			8,840	144	70	183,484			
Skipjack							1,344	7,768	3,524		6,262,942	5,137	2,487,399	8,768,114	3,182,899	2,284,076	5,466,975
Smelt	30,784	8,689	22,298			1,687	86,262	97,091	45,515	81,615	271,557	85,542	18,758	749,798	472	1,399	1,871
Sole	2,375	255,422				215	6,845,578	1,409,757	52,249	150,886	28,511	3,997	7,348	8,756,338	3,190	3,007	6,197
Splittail					6,412	145								6,557			
Striped Bass			1,415	80,079	177,231	495,027	83,964		57					837,773			
Suckers		4,972			100	25	612							5,709			
Swordfish											8,023		17,589	25,612		1,433	1,433
Tomcod			94				12,539	1,875						14,508			
Trout—Steelhead	222													222			
Tuna											384,333	1,130		385,463	41,390		41,390
Tuna—Bluefin											3,764,940	556	38,181	3,803,677			
Tuna—Yellowfin											2,841,074	138	122,408	2,963,620	5,947,255	4,327,023	10,274,278
Turbot		65	3,361				500							3,926			
Whitebait	38,017		4,845				28,106							70,968			
Whitefish										1,360	134,715	160	83,195	219,430	222	2,460	2,682
Yellowtail										476	1,351,658	911	1,233,576	2,586,621	318,767	274,503	593,270
Miscellaneous	559	15,081		201	55	248	9,722	9,859	14,491	20,808	132,267	12,362		215,653	14,810	235	15,045
Total fish	4,094,520	1,228,727	96,137	897,222	975,033	4,358,644	13,883,681	3,117,828	127,954,882	855,749	217,826,309	587,266	28,126,068	404,002,066	12,284,196	9,043,091	21,327,287
Crustaceans:																	
Crabs	[1]183,744	[2]13,200	[3]3,072				[5]2,959,728	[7]63,456	[8]11,112					[9]3,234,312			
Shrimps			868,065				592,169							1,460,234			
Spiny Lobsters										66,768	215,009	11,624	138,658	432,059	19,363	1,034,984	1,054,347
Mollusks:																	
Abalones									2,336,760	16,101				2,352,861	802		802
Clams—Cockle		482	2,509											2,991			
Clams—Mixed	17,724	6,646	35,903						120	445		47	879	61,764	75		75
Clams—Pismo									60	323,185				323,245			
Clams—Softshell		822	92,076			113,151	58,007							264,056			
Cuttlefish	32	49	99				15,568	24,989	92,461	43	138	15		133,394	55		55
Mussels							21,363		3,295	334		950		25,942			
Oysters—Eastern			[4]50,717				[6]518,286							[10]569,003			
Oysters—Native			165											165			
Squid							492		1,827,416		44,867		18,445	1,891,220			
Miscellaneous:																	
Turtles															21		21
Totals	4,296,020	1,249,926	1,148,743	897,222	975,033	4,471,795	18,049,294	3,206,273	132,226,106	1,262,625	218,086,323	599,902	28,284,050	414,753,312	12,304,512	10,078,075	22,382,587

All amounts shown in pounds unless otherwise specified. Albacore and skipjack cleaned.

[1] 7,656 dozen.

[2] 550 dozen.

[3] 128 dozen.

[4] 230,535 shell oysters.

[5] 123,322 dozen.

[6] 2,355,853 shell oysters.

[7] 2,644 dozen.

[8] 463 dozen.

[9] 134,763 dozen.

[10] 2,586,388 shell oysters.

REPORT ON FISH CANNERIES.

N. B. SCOFIELD,
In Charge Department of Commercial Fisheries,
Fish and Game Commission.

SIR: I beg to submit herewith a report on cannery activities for the past sardine season in California extending from June 1, 1925, to May 31, 1926.

The first canning operations were started at Monterey in June, 1925, and the last cannery closed down in April, 1926.

Canning operations were started in the San Pedro District in October, 1925, and extended to April, 1926, although most of the plants closed down in both Monterey and San Pedro in March. In San Diego the plants started in January and ran through to April 1, 1926. No fish was received in April but a small quantity was received by some of the plants during May.

The following table shows the activities at the various canning centers:

CANNERY, FISH FLOUR AND EDIBLE OIL PLANT PRODUCTION.

Season June 1, 1925, to May 31, 1926.

District	Cases 1-lb. oval pack per ton	Tons fish received	Tons fish used for canning	Tons fish used for meal and flour	Tons offal	Cases 1-lb. ovals packed
Monterey	15.6	69,011	45,587	19,832	16,193	937,014
San Pedro	16.3	61,992	49,192	12,800	16,643	[illegible]
San Diego	16	5,214	3,940	1,274	1,312	66,074
Northern California	16	248	164	54	65	[illegible]
Totals, all districts	15.9	136,465	101,913	33,960	34,213	1,975,475
Deduct fish used for other purpose		8,247	Add other sizes, 1-lb. ovals			65,382
Fish used by canning plants		128,218	Equal to total cases, 1-lb. ovals			2,040,857

District	Cases other sizes packed	Other sizes equivalent to cases of 1-lb. ovals	Meal, tons	Ratio per ton, meal	Oil, gallons	Gallons oil per ton of offal and fish	Tons of fish used for other purposes
Monterey	37,220	35,956	[1]6,393	5.7	1,110,983	30.8	[2]6,248
San Pedro	16,492	16,361	5,962	5	658,817	22.4	[3]1,729
San Diego	16,373	13,065	467	5.5	43,995	17	[4]270
Northern California			20	5.5	2,629	24.1	
Total, all districts	70,085	65,382	12,842	5.3	1,816,424	26.6	8,247

[1] 262 tons fish flour produced, not included in meal production.

[2] 592 tons used for salting purposes; 4,468 tons used for manufacturing fish flour; 1,188 tons used for manufacturing [illegible]

[3] 1,729 tons used for manufacturing edible oil.

[4] 270 tons used for manufacturing edible oil.

It is useless to comment on this table as a close study of it will show that the canneries located at each of the canning centers have produced over the requirements of General Order No. 1 of 15 cases of one-pound oval cans or equivalent number of cases of other size cans from each ton of fish received.

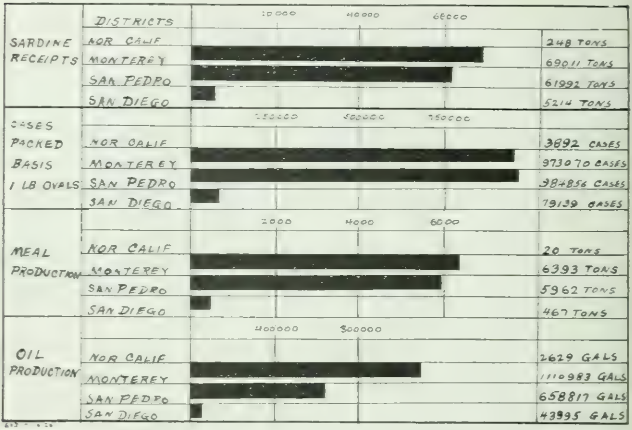
The meal ratio is based on the number of tons of offal and whole fish required to produce one ton of meal.

There seems to be considerable difference in the amount of meal and oil produced from a ton of fish and offal in various plants as will be shown in the following table of operations of each plant. There is also shown in this table the number of cases of one-pound oval cans or the equivalent thereof produced from each ton of fish received.

TABLE OF CASE PRODUCTION, RATIO OF MEAL AND OIL PRODUCTION.

Name of plant	Location	Kind of plant	Number of cases 1-lb. oval cans per ton	Ratio per ton of meal	Gallons of oil per ton of offal and fish
F. E. Booth Company	Pittsburg	Cannery	16	5.5	24.1
Bayside Fish Flour Company	Monterey	Fish flour		6.4	29.9
F. E. Booth Company	Monterey	Cannery	16.4	5	32.5
Carmel Canning Company	Monterey	Cannery	15.9	5.3	36.2
E. B. Grosse	Monterey	Cannery	15.4	5.1	33.3
Monterey Canning Company	Monterey	Cannery	14.7	6.1	21.6
California Packing Corporation	Monterey	Cannery	15.7	6.9	22.3
San Xavier Packing Company	Monterey	Cannery and salting	14	4.4	37.8
Sea Pride Canning Company	Monterey	Cannery	15.8	5.4	31.6
Hauser Packing Company	Monterey	Edible oil		5.4	32.5
K. Horden Company	Monterey	Cannery	14.9	5	34
Coast Fishing Company	Wilmington	Cannery	17.9	5.1	24
Franco-Italian Packing Company	East San Pedro	Cannery	15.2	6.3	22.5
French Sardine Company	East San Pedro	Cannery	18	3.2	28.8
Gilbert C. Van Camp	San Pedro	Cannery	9.6	4.6	29.8
Italian Food Products Company	Long Beach	Cannery	15.6	Scrap sold	22.4
Los Angeles Sea Food Company	East San Pedro	Cannery	16.9	4.6	24
Pacific Marine Products Company	East San Pedro	Cannery	11.1	5.6	14.2
Kittle-Joerissen Canning Company	East San Pedro	Cannery	8.6	6	.02
Southern California Fish Corporation	East San Pedro	Cannery	15	5.6	23.5
Seacoast Packing Company	East San Pedro	Cannery	16.5	5	21.2
Stafford Packing Company	Wilmington	Cannery	15.2	4.2	25
Toyo Fisheries Company, Inc.	Wilmington	Cannery	16.2	5.8	18
Van Camp Sea Food Corporation	East San Pedro	Cannery	16.8	5.1	20.7
Globe Oil Mills	Ostend	Edible oil		5.3	19
Cohn, Hopkins Company	San Diego	Cannery	15.7	4.6	25
K. Hovden Company	San Diego	Cannery	14.9	5.4	22.4
Neptune Sea Food Company	San Diego	Cannery	15.2	5.5	22.4
California Packing Corporation	San Diego	Cannery	20.7	Sold	offal
San Diego Packing Company, Inc.	San Diego	Cannery	12.3	7.4	10.7
Van Camp Sea Food Corporation	San Diego	Cannery	12.3	5	18.8
Westgate Sea Products Company	San Diego	Cannery	17.3	5.7	16.2
Hauser Packing Company	San Diego	Edible oil		5.6	20.4

For quick reference and comparison of activities in the Monterey, San Pedro and San Diego districts a chart is attached hereto showing receipts of fish, number of cases packed on the basis of one-pound oval cans, number of tons of meal, and gallons of oil produced.



Graphic comparison of Fish Receipts, Pack, Meal and Oil Production. California Sardine Season, 1925-1926.

This report does not cover the operations of the Monterey Fish Products Plant which took sardines in their reduction plant at Monterey during the early part of the season in violation of the Fish Reduction Act and were later closed for three months by a court order.

Respectfully submitted.

S. H. Dado,
Assistant, Department of Commercial Fisheries.

San Francisco, July 16, 1926.

STATEMENT OF EXPENDITURES FOR THE PERIOD JULY 1, 1924, TO JUNE 30, 1925, OF THE SEVENTY-SIXTH FISCAL YEAR.

	Materials and supplies	Salaries and wages	Service and expense	Property and equipment	Total
Administration—					
Commissioners			$946 59		$946 59
Executive offices	$440 86	$17,099 09	5,528 61	$491 54	23,560 10
Printing	8,415 40				8,415 40
Research and publicity	301 20	5,903 89	1,293 90	138 58	7,637 57
Accident and death claims			4,452 22		4,452 22
Total administration	$9,157 46	$23,002 98	$12,221 32	$630 12	$45,011 88
Commercial Fish Culture and Conservation—					
Superintendence	$1,016 51	$9,535 45	$3,435 98	$6 75	$13,994 69
Inspection and patrol	5,281 76	17,288 97	4,561 48	130 23	27,262 44
Research	2,200 01	15,648 81	3,989 47	751 58	22,589 87
Statistics	563 93	5,948 70	202 09		6,714 72
Propagation and distribution of salmon	10,753 02	14,793 95	1,202 01	535 15	27,284 13
Total commercial fish culture and conservation	$19,815 23	$63,215 88	$13,391 03	$1,423 71	$97,845 85
Sporting Fish Culture—					
Superintendence	$100 74	$10,260 32	$2,818 68	$78 53	$13,258 27
Special field investigations	230 52	2,365 32	861 47	805 41	4,262 72
Printing	152 75				152 75
Propagation and distribution of trout	36,206 55	60,042 69	11,578 78	13,597 20	121,425 22
Total sporting fish culture	$36,690 56	$72,668 33	$15,258 93	$14,481 14	$139,098 96
Patrol and Law Enforcement—					
Prosecutions and allowances			$66 57		$66 57
General patrol	$2,558 46	$141,011 35	93.104 07	$1,162 35	237,836 23
Total patrol and law enforcement	$2,558 46	$141,011 35	$93,170 64	$1,162 35	$237,902 80
Fish and Game Conservation—					
Game bird introduction	$1,812 30	$1,708 99	$4,955 46		$8,476 75
Game farm			16 69		16 69
Mountain lion hunting		1,500 00	870 77		2,370 77
Mountain lion bounties			6,100 00		6.100 00
State fair exhibit	298 33	1,006 00	2,079 57		3,383 90
Total fish and game conservation	$2,110 63	$4,214 99	$14,022 49		$20,348 11
License commissions			$47,297 40		$47,297 40
Tahoe camp grounds	$118 20	$602 00	16 66		736 86
Total expenditures	$70,450 54	$304,715 53	$195,378 47	$17.697 32	$588,241 86
Prior year expenditures					$1,062 80

STATEMENT OF EXPENDITURES FOR THE PERIOD JULY 1, 1925, TO JUNE 30, 1926, OF THE SEVENTY-SEVENTH FISCAL YEAR.

	Materials and supplies	Salaries and wages	Service and expense	Property and equipment	Total
Administration—					
Commissioners	$3 37		$191 39	$80 05	$274 81
Executive and legal	104 54	$10,047 97	1,652 64	349 95	12,155 10
Clerical and office	760 26	17,267 33	1,885 44	3,231 42	23,144 45
Rent			9,336 96		9,336 96
Printing	6,630 15				6,630 15
Postage			2,953 95		2,953 95
Freight, cartage and express			1,281 63		1,281 63
Telephone and telegraph			3,472 09		3,472 09
Automobile	193 94		131 35	1,775 88	2,101 17
Accident and death claims			4,087 99		4,087 99
Total administration	$7,692 26	$27,315 30	$24,993 44	$5,437 30	$65,438 30
Publicity and Research—					
Director of education and research	$3,256 93	$4,223 95	$1,732 59	$909 20	$10,122 67
Director of publicity	20 19	2,436 25	373 72	4 75	2,834 91
Printing	3,458 65				3,458 65
Total publicity and research	$6,735 77	$6,660 20	$2,106 31	$913 95	$16,416 23
Conservation and Protection—					
Patrol and law enforcement:					
Chief and assistant		$4,563 24	$603 75		$5,166 99
Captains and deputies	$1,470 47	132,888 91	93,429 19	$590 75	228,379 32
Patrol launches	1,040 20	2,382 33	856 24	116 50	4,395 27
Clerical and office	53 73	4,510 00	5 00		4,568 73
Rent			420 34		420 34
Automobiles	440 60		194 71	17 05	652 36
Protection:					
Lion hunting		1,500 00	839 72		2,339 72
Lion bounties			5,630 00		5,630 00
Total conservation and protection	$3,005 00	$145,844 48	$101,978 95	$724 30	$251,552 73
Commercial Fisheries—					
Chief and assistants	$368 78	$5,203 32	$815 43	$5 97	$6,393 50
Deputies	376 90	22,486 09	4,168 89	66	27,032 54
Laboratory and research	1,430 68	16,035 89	2,845 21	814 42	21,126 20
Statistical	670 48	5,815 26	297 31	99	6,784 04
Patrol launches	2,566 91	2,422 26	495 36	5,905 45	11,389 98
Salmon tagging	800 00		73 65		873 65
Total commercial fisheries	$6,213 75	$51,962 82	$8,695 85	$6,727 49	$73,599 91
Game Propagation—					
Game farm maintenance and operation	$8,535 76	$3,736 89	$3,384 89	$3,865 56	$19,523 10
Game farm additions and betterments				28,701 34	28,701 34
Total game propagation	$8,535 76	$3,736 89	$3,384 89	$32,566 90	$48,224 44
Fish Culture—					
Chief of division		$3,683 32	$225 38		$3,908 70
Special field investigations	$239 08	9,037 73	1,610 23	$870 23	11,757 27
Clerical and office	111 38	4 102 72	19 90	3 50	4,237 50
Printing	88 95				88 95
Hatcheries maintenance and operation	62,595 51	75,643 75	8,357 22	1,838 64	148,435 12
Hatcheries additions and betterments				9,587 97	9,587 97
Automobiles	1,047 79		890 64	3,202 52	5,140 95
Rent			836 60		836 60
Total fish culture	$64,082 71	$92,467 52	$11,939 97	$15,502 86	$183,993 06
License commissions			$48,791 10		$48,791 10
Total expenditures	$96,265 25	$327,987 21	$201,890 51	$61,872 80	$688,015 77

Comparative Balance Sheets at Beginning and End of Each of the Seventy-sixth and Seventy-seventh Fiscal Years.

	July 1, 1924	June 30, 1925	June 30, 1926
Debits			
Available appropriated funds	$11,630 49	$24,044 19	$157,288 55
Warrants receivable	67,327 79	49,282 46	43,550 17
Cash, state	17,911 75	57,189 08	77,245 27
Fish and game preservation fund	209,345 47	197,831 16	253,769 69
Accounts receivable	115 18	22,175 91	2 10
Bond deposits (licenses sold to agents)	71,670 00	118,102 00	66,508 00
Unissued licenses available	532,422 00	679,845 00	618,213 50
County clerks' unissued license supplies	292,967 00	300,539 00	303,869 00
Fish tags available	3,261 41	4,262 52	3,240 86
Game tags available	320 13	243 29	203 27
Revolving fund appropriated	----------	----------	12,500 00
Unclaimed trust moneys	----------	----------	259 45
Total debits	$1,206,971 22	$1,453,514 61	$1,536,649 86
Credits			
Appropriations for support	$1,012 92	$10,605 16	$10,669 10
Appropriations for salaries	----------	102 00	275 01
Deficiency appropriations	10,617 57	13,337 03	146,344 44
Claims filed	67,327 79	49,282 46	43,550 17
Accumulated excess income	227,372 40	277,196 15	343,517 06
Liability for bond deposit	71,670 00	118,102 00	66,508 00
Accountability for licenses	825,389 00	980,384 00	922,082 50
Accountability for fish tags	3,261 41	4,262 52	3,240 86
Accountability for game tags	320 13	243 29	203 27
Income suspense	----------	----------	----------
Liability for canceled checks	----------	----------	259 45
Total credits	$1,206,971 22	$1,453,514 61	$1,536,649 86

Comparative Statement of Income for the Fiscal Years 1924-1925 and 1925-1926.

	Seventy-sixth fiscal year, 1924-1925	Seventy-seventh fiscal year, 1925-1926
License sales—		
Angling	$179,846 00	$307,302 00
Hunting	236,632 00	235,610 00
Market fishermen's	43,450 00	54,321 00
Trapping	2,875 00	3,700 00
Wholesale fish packers' and shell fish dealers'	1,195 00	1,365 00
Game breeders'	325 00	377 50
Fish breeders'	65 00	95 00
Kelp	20 00	20 00
Total license sales	$464,408 00	$602,790 50
Other income—		
Court fines	$45,654 00	$52,714 75
Fish packers' tax	105,100 79	83,200 15
Kelp tax	----------	2 26
Fish tag sales	5,998 89	5,022 53
Game tag sales	76 84	57 02
Abalone inspection	----------	210 43
Crawfish inspection	300 00	----------
Interest on bank deposits	1,895 09	2,762 27
Sales of nets and lines	15 80	491 00
Sales of beaver hides	345 00	10 00
Sale of launches	300 00	50 00
Total other income	$159,686 41	$144,520 41
Total income	$624,094 41	$747,310 91

48323 1-27 3650

MELONES DAM ON STANISLAUS RIVER.

Completed in 1926 by Oakdale and South San Joaquin Irrigation Districts. Capacity 121,899 acre-feet. A typical case of coordinated irrigation and power development where the construction of agricultural storage was assisted by the prospect of income to be derived from the sale of by-product hydro-electric power.

PLATE 1.

PART III

Biennial Report

OF THE

Division of Water Rights

(FORMERLY STATE WATER COMMISSION)

A SUBDIVISION OF THE

DEPARTMENT OF PUBLIC WORKS

OF THE

STATE OF CALIFORNIA

To Accompany the Third Biennial Report of
that Department and Being the Sixth Biennial
Report of the Division of Water Rights and
State Water Commission

NOVEMBER 1, 1926

EDWARD HYATT, Jr., Chief of Division

CALIFORNIA STATE PRINTING OFFICE
CHARLES A. WHITMORE, State Printer
SACRAMENTO, 1927

47854

CONTENTS.

LIST OF CHAPTERS.

CHAPTER I.

Page.
PERSONNEL 7
INTRODUCTION 9
  Water Commission Act 9
  Previous Reports 9
  Activity in Biennial Period 10
  Statutory Functions 10
  Development of Office 10
  Diagrammatic Record of Accomplishment 12
  Results of Reorganization 13
  Present Position 13
  Future 13
  Supervision of New Water Rights 14
  Determination of Existing Rights 15
  Shasta River Adjudication 16
  Distribution of Water 16
  Special Investigations 17
  Kings River 18
  San Gabriel River 18
  Sacramento-San Joaquin Investigation 18
  Colorado River 19
  Legal Department 19
  New Legal Problems 20
  Herminghaus v. Southern California Edison Co. 20
  Cooperation with United States Government 22
  Financial Statement 22
  Los Angeles and Fresno Offices 22
  Publications 23
  Public Interest in Water Questions 23

CHAPTER II.

SUPERVISION OF THE APPROPRIATION OF WATER 25

CHAPTER III.

ADJUDICATION OF EXISTING WATER RIGHTS 37
  Burney Creek 42
  Stanislaus River 43
  Shasta River 43
  Whitewater River 43
  North Cow Creek 43
  Oak Run Creek 43
  Owl Creek 44
  Soldier Creek 44
  Morrison Creek 44
  Clover Creek 45
  Butte Creek 45

CHAPTER IV.

ADMINISTRATIVE DISTRIBUTION OF WATER 47
  Kings River 50
  Sacramento River 50
  Shasta River 50
  Hat Creek 51
  Burney Creek 51
  Owl Creek 52
  Soldier Creek 52
  Cedar Creek 54
  North Cow Creek 54
  Oak Run Creek 54

CHAPTER V.

WORK OF LEGAL DEPARTMENT 55

CHAPTER VI.

PROGRESS ON KINGS RIVER 64

CHAPTER VII.

UNDERGROUND WATER INVESTIGATION IN SOUTHERN SAN JOAQUIN VALLEY 67

CHAPTER VIII.

SAN GABRIEL INVESTIGATION 70

CHAPTER IX.

SACRAMENTO AND SAN JOAQUIN RIVERS 75
  1. Second Sacramento-San Joaquin River Problems Conference 75
  2. Sacramento-San Joaquin Water Supervisor 81

CHAPTER X.

FINANCIAL STATEMENT, July 1, 1924, to June 30, 1926 98

APPENDICES.

Appendix A. Page
SALINITY 100

Appendix B.
RETURN WATER—SACRAMENTO AND SAN JOAQUIN RIVERS 104

Appendix C.
DELTA DUTY OF WATER—SACRAMENTO AND SAN JOAQUIN RIVERS 114

Appendix D.
REPORT ON COOPERATIVE STREAM FLOW MEASUREMENTS 135

Appendix E.
IMPORTANT APPLICATIONS AND PERMITS FOR THE BIENNIAL PERIOD 139

LIST OF TABLES.

Table No. Page.

1. Numerical Summary by Biennial Periods of Applications Received and Permits and Licenses Issued 14
2. Summary of Proposed Development by Counties as Shown by Applications Received and Permits Issued During Biennial Period Ending September 1, 1926 24
3. Statistical Summary Relative to Field Investigations 26
4. Summary of Adjudication Proceedings 41
5. Adjudication Cost Data 46
6. Summary of Results—San Gabriel Valley 74
7. Sacramento-San Joaquin Diversions and Acreages Irrigated, 1924 and 1925 92
8. Summary of Sacramento River Diversions—1925 92
9. Summary of Acreage and Crops Irrigated in the Sacramento-San Joaquin Delta—1925 and 1926 94
10. Financial Statement—Showing Income and Expenditures—76th and 77th Fiscal Years 98
11. Salinity Observation Stations Maintained by Sacramento-San Joaquin Water Supervisor—1925 and 1926 100
12. Comparison of Maximum Salinity, 1920-1924-1926-Sacramento-San Joaquin Delta 102
13. Comparison of Total Stream Flow Tributary to San Francisco Bay and and Maximum Salinities—1919 to 1925, inclusive 103
14. Measured Return Flow in Definite Channels Tributary to Sacramento River—1925 and 1926 104
15. Relation Between Return Water and Draft, Sacramento River, Red Bluff to Sacramento, July to October, 1925 106
16. Return Water in Colusa Trough at Colusa—Williams Highway, 1925 and 1926 108
17. Return Flow in San Joaquin Valley Streams—1925 and 1926 109
18. Duty of Water—Observed Data, Medford Island Tanks—1925 118
19. Duty of Water—Results of Experiments with Tanks on King Island, 1925 123
20. Use of Water from Irrigation Ditches and from Drains—King Island Tanks—1925 124
21. Use of Water in Lower Unit of Reclamation District Number 999 125
22. Comparison of Determinations for 1924 and 1925 on Reclamation District Number 999 128
23. Crop Acreages in the Lower Unit of Reclamation District Number 999 for the Season of 1925 128
24. Expenditures for Cooperative Water Resources Investigations in California Through the Water Resources Branch of the United States Geological Survey 135
25. Summary of River Measurement Work and Expenditures 137
26. Important Proposed Irrigation Projects as Indicated by Applications to Appropriate Water Filed during the Biennial Period Ending September 1, 1926 140
27. Important Proposed Power Projects as Indicated by Applications to Appropriate Water Filed during the Biennial Period Ending September 1, 1926 143
28. Important Proposed Mining Projects as Indicated by Applications to Appropriate Water Filed during the Biennial Period Ending September 1, 1926 145
29. Proposed Municipal Projects as Indicated by Applications to Appropriate Water Filed during the Biennial Period Ending September 1, 1926 146
30. Important Permits Issued for Agricultural Purposes during Biennial Period Ending September 1, 1926 147
31. Permits Issued for Power Purposes during Biennial Period Ending September 1, 1926 153
32. Permits Issued for Mining Purposes during Biennial Period Ending September 1, 1926 155
33. Permits Issued for Municipal Purposes during the Biennial Period Ending September 1, 1926 157

LIST OF PLATES.

Plate No.		Page.
1.	Melones Dam on Stanislaus River	Frontispiece
2.	Organization Chart—1926	6
3.	Applications Received—Actions and Expenditures—Appropriations for Salary and Support	9
4.	Big Creek Power House No. 3 of Southern California Edison Company	11
5.	Hydraulic Mining in Siskiyou County	15
5A.	Bowman Dam on Canyon Creek in Nevada County	17
6.	Water Supply Conduit of East Bay Municipal Utility District	21
7.	Applications Received and Actions—Shown by Cumulative Totals	27
7A.	Applications Received, Showing Relative Number for Various Uses	27
8.	Second-Feet Applied for and Acted Upon, Shown by Cumulative Totals	29
8A.	Acre-Feet Applied for and Acted Upon, Shown by Cumulative Totals	29
9.	Acreage to be Irrigated, Shown by Cumulative Totals	31
9A.	Theoretical Horsepower to be Developed, Shown by Cumulative Totals	31
10.	Florence Lake Dam on San Joaquin River	33
11.	Balch Power House	35
12.	Diagrammatic Profile—Kings River Development, San Joaquin Light & Power Corporation	36
13.	Burney Falls on Burney Creek, Shasta County	39
14.	Automatic Water Stage Recorder Installation	53
15.	Map—Mokelumne River Project East Bay Municipal Utility District	61
16.	Map—Kings River Area	64
17.	Key Map San Gabriel Investigation	70
18.	Hydrological Diagram	73
19.	Along the Victory Highway in the Sacramento River Delta	77
20.	Field of Rice, Natomas District, Sacramento Valley	79
21.	Cutting Asparagus in the Sacramento River Delta	80
22.	Map—Sacramento and San Joaquin Valleys	83
23.	Irrigation in the Delta Uplands	85
24.	Barges of Grain from Up-River Points at City of Sacramento Wharves	87
25.	Picturesque Sacramento River Diversion Above Sacramento	89
26.	Loading Celery from Island Levee, San Joaquin River Delta	90
27.	Comparative Discharge of Sacramento River at Red Bluff and Sacramento	91
28.	One of the Largest Pumping Plants on the Upper Sacramento River	93
29.	Celery on the Peat Lands of the Sacramento-San Joaquin Delta	95
30.	Onion Seed Crop, Reclamation District 999, Sacramento River Delta	95
31.	Map—Sacramento and San Joaquin Delta, Showing Salinity Observation Stations	100
31A.	Typical Source of California Water Supply. Snow Fields in the Higher Mountains	99
32.	Relation of Salinity in the Sacramento-San Joaquin Delta to River Discharge	102
33.	Cumulative Draft and Return Flow Sacramento River, Red Bluff to Sacramento, July 1 to October 31, 1925	107
34.	Map—Location of Return Water Measurements in San Joaquin Valley	108
35.	Rate of Accretion of Return Flow in Stanislaus and Tuolumne Rivers	111
36.	Rate of Accretion of Return Flow in San Joaquin River	112
37.	Rate of Accretion of Return Flow in Merced River	113
38.	Irrigation of 93.55 acres of Potatoes, Medford Island, 1925	115
39.	Weighted Platform Used in Forcing Inner Cylinder Tanks Down Into Peat, Medford Island, 1925	116
40.	Tank Installation, Medford Island, 1925	116
41.	Accumulated Use of Water, Tank No. 22, Medford Island, 1925	117
42.	Response of Ground Water Level to Tidal Action, Medford Island, 1925	119
43.	Irrigation of 21.97 Acres of Potatoes, King Island, 1925	120
44.	Average Depth of Water Below Ground Surface during the Irrigation Season, King Island Potato Field, 1925	121
45.	King Island Tanks Immediately after Installation, May 14, 1925	122
46.	King Island Tanks, July 11, 1925	122
47.	Accumulated Use of Water from Potato Tanks, King Island, 1925	126
48.	Potato Field Under Observation, King Island, 1926	130
49.	Corn Tanks, King Island, 1926	130
50.	Placing Tanks, Reclamation District 999, 1926	132
51.	Undisturbed Soil in Placing Tanks, Reclamation District 999, 1926	132

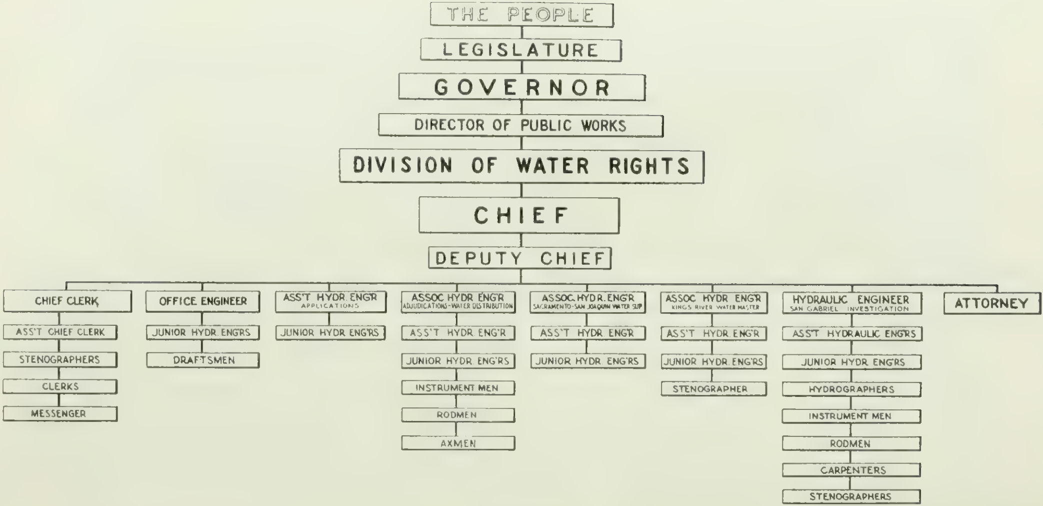

THE PEOPLE
LEGISLATURE
GOVERNOR
DIRECTOR OF PUBLIC WORKS
DIVISION OF WATER RIGHTS
CHIEF
DEPUTY CHIEF
CHIEF CLERK
ASS'T CHIEF CLERK
STENOGRAPHERS
CLERKS
MESSENGER
OFFICE ENGINEER
JUNIOR HYDR. ENG'RS
DRAFTSMEN
ASS'T HYDR. ENG'R
APPLICATIONS
JUNIOR HYDR. ENG'RS
ASSOC. HYDR. ENG'R
ADJUDICATIONS-WATER DISTRIBUTION
ASS'T HYDR. ENG'R
JUNIOR HYDR. ENG'RS
INSTRUMENT MEN
RODMEN
AXMEN
ASSOC. HYDR. ENG'R
SACRAMENTO-SAN JOAQUIN WATER SUP
ASS'T HYDR. ENG'R
JUNIOR HYDR. ENG'RS
ASSOC. HYDR. ENG'R
KINGS RIVER WATER MASTER
ASS'T HYDR. ENG'R
JUNIOR HYDR. ENG'RS
STENOGRAPHER
HYDRAULIC ENGINEER
SAN GABRIEL INVESTIGATION
ASS'T HYDRAULIC ENG'RS
JUNIOR HYDR. ENG'RS
HYDROGRAPHERS
INSTRUMENT MEN
RODMEN
CARPENTERS
STENOGRAPHERS
ATTORNEY

PLATE 2.

State of California

Department of Public Works

DIVISION OF WATER RIGHTS

PERSONNEL.

Administration

PAUL BAILEY	Director of Public Works
EDWARD HYATT, JR.	Chief of Division of Water Rights
EVERETT N. BRYAN	Deputy Chief of Division
KATHERINE A. FEENY	Chief Clerk

Legal

SPENCER BURROUGHS	Attorney

Engineering

HAROLD CONKLING	Hydraulic Engineer (San Gabriel Investigation)
CHARLES L. KAUPKE	Associate Hydraulic Engineer (Kings River Water Master)
HARLOWE M. STAFFORD	Associate Hydraulic Engineer (Sacramento-San Joaquin Water Supervisor)
GORDON ZANDER	Associate Hydraulic Engineer (Adjudication, Water Distribution)
MARK S. EDSON	Assistant Hydraulic Engineer (Office Engineer)
WALTER E. STODDARD	Assistant Hydraulic Engineer (Applications, Permits, Field Investigations)

HISTORICAL LIST OF OFFICERS

STATE WATER COMMISSION AND DIVISION OF WATER RIGHTS

W. A. JOHNSTONE, Member of State Water Commission, March 24, 1915, to January 4, 1921. President of State Water Commission, March 24, 1915, to January 3, 1918.

A. E. CHANDLER, Member of State Water Commission, March 24, 1915, to October 1, 1919. President of State Water Commission, January 3, 1918, to October 1, 1919.

IRVING MARTIN, Member of State Water Commission, March 24, 1915, to December 30, 1918.

R. L. RILEY, Member of State Water Commission, January 1, 1919 to August 5, 1919.

A. W. MASON, Member of State Water Commission, August 5, 1919, to July 29, 1921.

J. L. MATTHEWS, Member of State Water Commission, January 4, 1921, to July 29, 1921.

CHAS. H. LEE, Member and President of State Water Commission, October 1, 1919, to July 29, 1921, and Chief of Division of Water Rights July 29, 1921, to November 30, 1921.

PAUL BAILEY, Acting Chief of Division of Water Rights, December 1, 1921, to December 31, 1921.

H. A. KLUEGEL, Chief of Division of Water Rights, December 31, 1921, to January 31, 1924.

EDWARD HYATT, JR., Acting Chief and Chief of Division of Water Rights, February 1, 1924, to date.

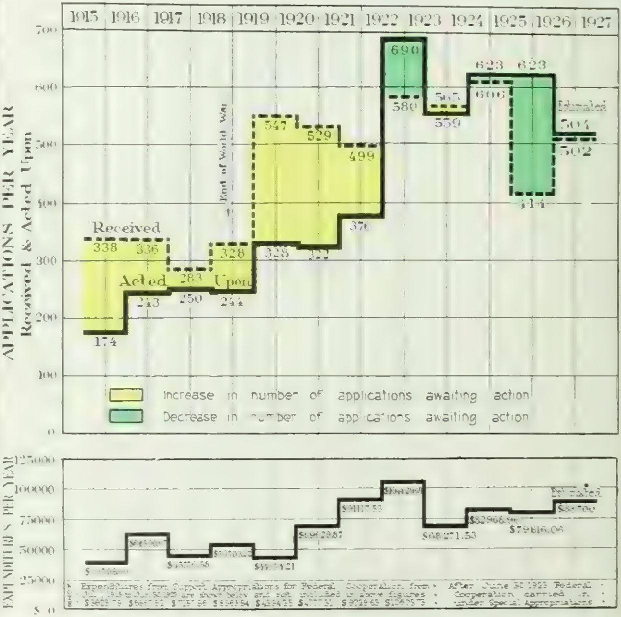
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

DIVISION OF WATER RIGHTS

APPLICATIONS RECEIVED ACTIONS & EXPENDITURES

APPROPRIATIONS FOR SALARY & SUPPORT

BY FISCAL YEARS



APPROPRIATIONS

Fiscal Years		67th & 68th	69th & 70th	71st & 72nd	73rd & 74th	75th & 76th	77th & 78th
Amount		$117547.03	$160000.00	$136218.13	$233700.00	$150481.42	$169175.00

1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927

PLATE 3.

REPORT OF DIVISION OF WATER RIGHTS OF STATE DEPARTMENT OF PUBLIC WORKS.

NOVEMBER 1, 1926.

CHAPTER I.

INTRODUCTION.

The following report contains a summary of the work of the Division of Water Rights of the Department of Public Works for the period September 1, 1924, to September 1, 1926, excepting the financial statement which covers the seventy-sixth and seventy-seventh fiscal years—July 1, 1924, to June 30, 1926, inclusive.

Water Commission Act.

The Division of Water Rights is the successor of the State Water Commission which was created in 1914 by the adoption at the general election in that year of the Water Commission Act (Chap. 586, Stats. 1913). This act had been passed by the 1913 legislature but was restrained from operation by referendum. The Water Commission came within the reorganization acts of 1921 (Chaps. 602 and 607, Stats. 1921) and in that year became the Water Rights Division of the Department of Public Works. This administrative regrouping of offices into departments did not amend or affect the duties of the office but transferred those duties to the new Division and Department, the Water Commission Act remaining unchanged. This has resulted in some confusion as to the proper name of the office, it being referred to both as the Division of Water Rights and as the State Water Commission, the former being correct. When reference is found in this report to the Water Commission, this will refer to the organization prior to the establishment of the Department the date of which was July 29, 1921.

Previous Reports.

A list of the printed publications of the office is given on the inside page of the back cover of this volume, which accompanies the third biennial report of the Department but is the sixth biennial account of the activities of the office functioning under the Water Commission Act. As will be more fully brought out later the office during its twelve years of existence has been in a developmental period and these five previous reports trace the history of its activities. Explanations are to be found therein of the act and the rules and regulations, previous water law history and purposes of the office as well as complete and accurate statements of the accomplishments of the biennial periods. In this report the effort has been made in the interests of brevity to limit the presentations to activities of the biennium and to matters not covered in earlier accounts, and to make free reference to the more detailed earlier discussions. The last two preceding biennial statements—those of 1922 and 1924—are the most complete and instructive in this regard and will be referred to most often. It will be necessary therefore for the student of water law administration in California, through the operations of the Water Commission Act, to have available several or all of these reports, most of which are still publicly available.

Activity in Biennial Period.

The activities and accomplishments of the Division in the past biennium have been materially greater than in any such earlier period. As the readily available water resources of the state have diminished the demand for such remaining waters has steadily increased. It is now generally admitted that California's growth is limited only by her water supply and realization is here that such water supply is not unlimited. Under the law of appropriation the inexpensive and easily developed "natural flow" of the stream is taken by the early comer and the late comer must resort to expensive storage of winter floods if, indeed, he is not too late even for that. The recent cycle of dry years, which it is hoped is now history, has accentuated the demand. These facts, together with the general prosperity of the state, furthering the greatest known agricultural, hydro-electric power and municipal projects, have focused popular attention to a degree not before known on water projects and water matters generally, which interest is reflected in the work of the Division of Water Rights.

Statutory Functions.

The functions of the office may be broadly grouped under four heads as follows:

Supervision of new rights to water.
Adjudication of existing rights.
Distribution of water to those entitled to the use thereof.
General investigation of streams and stream systems.

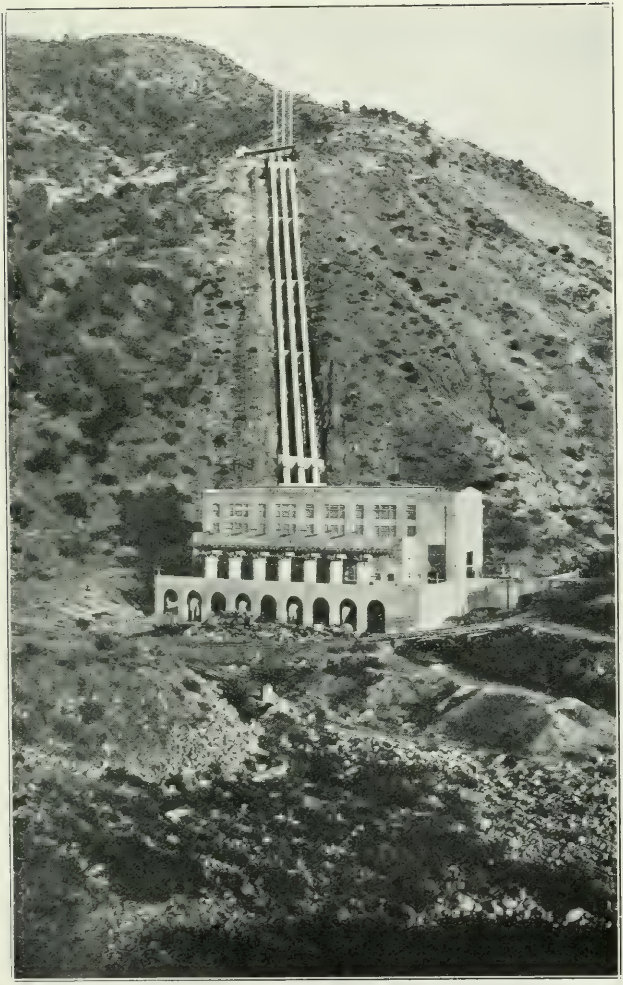
The various activities of the office under each of these headings are outlined in the succeeding chapters of this report.

Development of Office.

Over sixty years of water troubles and litigation led up to the passage of the Water Commission Act in 1913. The gold miners created the principle of "appropriation" of water out of the necessity of the time, and the new state in 1850 adopted the common law of England and with it the riparian doctrine. Out of these two early actions has come unfortunate and expensive history. This history has been told often and well and need not be repeated here. The opening paragraphs of Chapter I of the 1924 report of the Division summarizes the growth of court law and its inadequacy and Chapter II of the same report under the title of "Historical and Legal Review of Water Rights in California" traces the legal development in detail.

The Water Commission Act, as passed in 1913, was intended to provide a complete code for the administration of the principle of appropriation of water which doctrine prior to that time had been expressed in an entirely inadequate manner by a few sections of the Civil Code.

When the Commission organized in 1915 to put the act into effect, a most difficult situation was encountered as the years of litigation



BIG CREEK POWER HOUSE No. 3 OF SOUTHERN CALIFORNIA EDISON COMPANY.

This is one of a series of power houses now in process of construction on San Joaquin River by which the waters of that stream and its tributaries are dropped through an approximate total head of 6,000 feet and utilized for power purposes under permits from the Division of Water Rights.

PLATE 4.

had left in their wake hundreds of Supreme Court decisions on water matters, many conflicting, incomplete or obsolete but nevertheless the law of the state. There were constitutional questions in the act itself and it speedily developed that for several reasons amendments were necessary. From 1915 to the present time the Commission and Division of Water Rights have been slowly but definitely progressing in the working out of procedure and precedent for the legal and efficient conduct of the office. For a few years especially it was necessary to move slowly through the mystic legal maze, but in later years much more rapid progress has been possible. The Water Commission Act has been amended at each legislative session since 1915. The original act contained an imperfect adjudication procedure and practically nothing on distribution. These and other features have been added, the statute being thereby improved and strengthened.

Precedent in procedure and experience in personnel have been next in importance to proper legal foundation in accomplishing greater results. Difficult questions once satisfactorily settled whether by analysis, court decree or chance, are available for future use without repetition of effort, and the training of an experienced staff through several years work in the office itself has been even more important.

Diagrammatic Record of Accomplishments.

Of the four major functions there is one which lends itself readily to graphical representation. This is the supervision of new rights to water which so far has been the largest of the four duties. The colored chart facing page 9 shows year by year since 1915 the number of applications for water received and the number acted upon, with the increase or decrease in pending cases represented approximately by the yellow and blue areas. On the lower half of the diagram are shown the annual expenditures of the office and the biennial appropriations made by the legislature. While the expenses cover all functions and the upper chart but one, the increase in all lines of endeavor has been at somewhere near the same rate, so that an approximately correct relation between expenditures and output is shown.

A number of interesting facts in the history of the office are brought out by the diagram. It shows that for the years 1915–1919 applications were received at a rate slightly over 300 per year but that upon the termination of the great war and the subsequent liberation of man power and money power that the rate nearly doubled and has remained at a high figure since. A point not brought out by the chart is that while the number of applications increased, the size or importance per application also increased, as the great irrigation and power projects now under construction mainly had their inception soon after the war.

The years 1919 to 1921 were parlous years for the office because while the work had approximately tripled, the funds had decreased, the appropriation for that biennium being $136,218 as against $160,000 for the previous two years. In the earlier period the entire appropriation was not used, which led the legislature to the erroneous conclusion that a smaller amount would be sufficient for the forthcoming biennium. The result is shown on the diagram by the large yellow area representing applications awaiting action, which at one time reached the number of 945. Prospective water users were rather severely penalized during this period by the division's lack of funds, as work was more than a year in arrears.

This situation being brought to the attention of the 1921 legislature, ample funds were appropriated, but on account of the extremely specialized technical and legal character of the work greater funds did not provide immediate relief. It was necessary to effect a complete reorganization of the Division's work along broader lines and to employ and train a much larger staff. These measures, along with increased expenditures, first brought results in 1922–1923 and have been increasingly successful from that time to the present.

Results of Reorganization.

A recent analysis shows that during the last four years 3123 applications to appropriate water have been acted upon by the division as against 1755 in the preceding four years, an increase of 78 per cent with an increased cost of operation of less than 18 per cent. A decrease in unit costs or an increase of efficiency of approximately 35 per cent for the past biennium is evidenced by these figures. The number of applications awaiting action has been reduced from 945 to 645 or 32 per cent. This decrease in pending cases resulting from the larger number of actions than of incoming applications is represented on the chart by the blue area which depicts graphically the very material reduction in the mass of work which had accumulated from 1919 to 1922.

Present Position.

With the building up of precedent and of the valuable experience of the office personnel standardization of procedure has been possible to a degree unthought of a few years ago. This is particularly true in the field of applications to appropriate where standardization and precedent have reached the point where the future can be faced with confidence. In the other lines of work the same effect is apparent but not to the same degree.

The figures just quoted showing greatly increased output at a less unit cost, accompanied by a cleaning up of accumulated back work mean that economies have been effected, delays eliminated and action on water matters expedited. This statement should be of interest to water users present and prospective as the Division of Water Rights is the bottleneck through which all new water projects, whether irrigation, power, municipal or what not must pass and delay or inefficiency here would retard or defeat water development. The aim of the office has been to deliver a maximum of prompt, courteous and efficient official service and it is with pride that the above record is submitted.

Future.

Looking to the future it is probable that standardization can be further extended with resulting economies. This will be true more in regard to adjudication of rights and distribution of water than as to applications, although the developmental period even in this line is probably not over. A review of the last few reports of the office shows that each considered the procedure at that time just about complete in view of the progress which had been made during the period covered which inference recommends caution in this statement regarding the limitation of further progress. It is concluded that it is not improbable that the future may still further reduce costs and the number of pending cases, and improve and expedite adjudications and allied problems. This conclusion must be predicated upon two conditions, first that legislative economy programs will not reduce the funds available below the necessary costs, and, second, that the experienced staff of the office can be maintained.

Supervision of New Rights to Water.

The receipt of and passing upon applications to appropriate water is the first of the major statutory functions of the Division of Water Rights, and as already noted has been the most important function in the history of the office. While this has been true during the last two years, it has become relatively less so than formerly, due to the more rapid increase in other phases of the work.

TABLE 1.

Numerical Summary by Biennial Periods of Applications Received and Permits and Licenses Issued.

	Totals to Dec. 1, 1916	Dec. 1, 1916, to Sept. 1, 1918	Sept. 1, 1918, to Sept. 1, 1920	Sept. 1, 1920, to Sept. 1, 1922	Sept. 1, 1922, to Sept. 1, 1924	Sept. 1, 1924, to Sept. 1, 1926	Totals
Applications received	524	531	925	1.023	1.161	1.001	5.165
Agricultural	429	380	658	577	664	585	3.293
Power	33	61	144	267	180	139	824
Mining	48	73	70	74	86	84	435
Municipal	8	6	26	28	52	61	181
Domestic	6	11	27	77	179	132	432
Applications closed	85	153	314	[illegible]	[illegible]	[illegible]	[illegible]
Applications pending—end of period	231	350	644	[illegible]	555	664	664
Permits issued	208	259	267	384	664	793	2.575
Agricultural	173	199	199	278	418	497	1.764
Power	9	14	23	45	60	58	209
Mining	22	37	34	24	65	57	239
Municipal	0	1	2	5	8	16	32
Domestic	4	8	9	32	113	165	331
Permits revoked	5	32	53	184	160	170	554
Permits pending—end of period	202	393	552	744	1.029	1.474	1.474
Licenses issued	1	36	55	58	219	178	547
Agricultural	0	23	33	30	149	119	354
Power	1	2	8	8	5	10	34
Mining	0	5	7	14	27	5	58
Municipal	0	0	0	0	0	1	1
Domestic	0	6	7	6	38	43	100
Licenses revoked	0	0	0	1	4	34	39
Licenses active—end of period	1	36	55	57	215	144	508

Table 1 is a numerical summary by report periods of the salient data concerning applications, permits and licenses. The progress that has been made in dealing with these matters is clearly shown by this table. An application, if approved, becomes a permit to divert and use water, and if water is beneficially used under the permit, a license issues. As the construction of works and the actual applying of the water to use ordinarily occupies a period of several years, the number of licenses so far issued is small compared to the number of applications filed. Chapter II of this report contains a detailed statement of the work of the Division along this line in the last two years. Chapter II also contains an explanation of recent amendments to the Water Commission Act and their effects, as well as a description of some of the more important projects which have received permits.

Table 2 at the end of this chapter contains a summary for each county in the state of the agricultural and power development as proposed and as approved during the report period.

Determination of Existing Rights.

It is inevitable that the subject of water rights is complicated and difficult to handle. Water is an elusive and obscure subject physically, and legally it is extremely complicated. It is difficult to measure the flow of a stream of water and impossible to accurately anticipate what it may be in the future. Legally, a water right may have been acquired by appropriation, by prescription, or under the riparian doctrine, or through a combination of such titles. The practical validity of a water right is also dependent upon such items as the amount of water flowing, the time of year, the location of the point of diversion, etc.

HYDRAULIC MINING IN SISKIYOU COUNTY.

Hydraulic mining in Siskiyou County was not effected by the debris laws of 1884. In this case 100 second-feet are in use under permit from the Division of Water Rights on a single mining property.

PLATE 5.

Titles to water having been built up under such conditions through many years, it is apparent that on any stream system where there are more than a few water rights, there is bound to be confusion, if not conflict, among the users as to priority of right. The settlement of such conflicts through the courts has, in general, not provided satisfactory solutions, since a suit usually would be brought by one user against one or more other users, and, when decided, would settle only the priority as between the parties to the suit, without regard to other users from the stream. To afford a workable and lasting settlement of water rights, all users or rather all claimants of water rights from the source in question should be brought into the proceedings. Even if all claims were included in a court action, the court generally was handicapped by the impossibility of securing the necessary physical data regarding flow of water, use thereof, and other such items.

The Water Commission Act supplied a remedy for this deficiency by providing a method whereby the Division of Water Rights could work with the courts in the adjudication of water rights. This is the second of the basic functions of the Division. During the first two years of the existence of the office, there was little, if any, of this class of work, but with the success of the first few adjudications undertaken, an increasing number of streams have been referred to the Division for investigation and adjudication. During the last two years five new stream systems have been referred to the Division and work has continued on six proceedings pending at the beginning of the biennium, one of which is now completed. Therefore, during the period under consideration, adjudication work on twelve different stream systems has been in progress. This work is described in Chapter III of this report, the various steps of the proceeding being outlined briefly. A statement of the costs is also given, and it is possible for any area wishing to adopt this method of settling its water problems to forecast the approximate cost thereof.

Shasta River Adjudication.

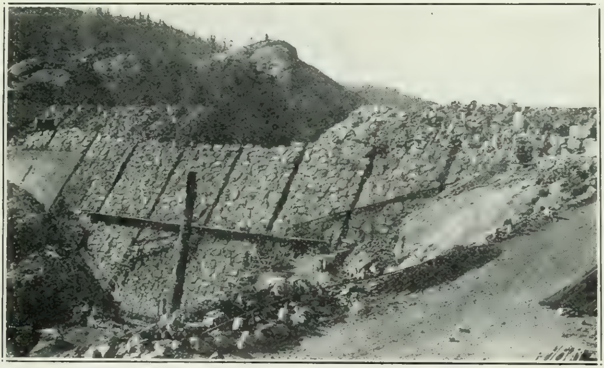
The magnitude of some of these cases is well illustrated by the Shasta River adjudication which is now in progress. In this proceeding all of the water rights on Shasta River and its tributaries in Siskiyou County are being determined. There are in excess of forty thousand acres of irrigated land in Shasta Valley—two irrigation districts, two mutual water companies, one interstate power concern, a great many diversion ditches and about six hundred separate water rights. Many of the ditches first diverted water shortly after 1850, at which time no records were kept and concerning which no witnesses now living can testify. The difficulty of establishing the relative priority of six hundred claims to water under these conditions becomes apparent.

Field work was started on this adjudication in 1921, and took two years for completion. Compilation of reports, collection of claims to water and various other matters took until 1925 when an abstract of claims was issued and contests received. Only twenty-eight contests were filed, which were recently the subject of a hearing at Yreka. It is expected that the Division's order of determination will be ready for submission to the superior court of Siskiyou County within a few months.

Distribution of Water.

When the various rights upon a stream have been determined and the extent of each right is known, it becomes possible for a water master to take charge of the stream and distribute the flow to those entitled to its use. This is the most effective and, in fact, the only practical method by which the legal owners of water rights can be protected in the exercise of those rights, because in the absence of a water master it is difficult to prevent the diverters highest up on the stream from making use of the water, regardless of the priority of their claims thereto. The necessity for water master service does not arise during years of plentiful water supply, but is made apparent by critical years, such as 1924, when the whole state was far below normal in the matter of rainfall and run-off

Distribution of water is the ultimate aim not only of the adjudication procedure, but of the whole water code as expressed by the Water Commission Act. Rights initiated since 1914 are recorded and supervised through the application procedure, existing rights of previous date are determined, and then distribution becomes practicable. When distribution is tried on a stream system the difficulties disappear. A competent engineer is put in charge in conformity with the decree establishing the rights and the available water is made to yield the utmost service. The cost of such work is trivial compared to the saving and to the freedom from litigation and trouble.



BOWMAN DAM ON CANYON CREEK IN NEVADA COUNTY.

Nevada Irrigation District has removed the historic Bowman Dam of mining days and is replacing it with another and larger rock fill dam with concrete instead of plank facing thereby creating 73,000 acre-feet of storage capacity which will be used for irrigation and power purposes under permits issued by the Division of Water Rights on May 19, 1925.

PLATE 5A.

The Division of Water Rights has had an increasing amount of such work, particularly in northern California. A full explanation of the activities of the biennium in this connection will be found in Chapter IV of this report.

Special Investigations.

The Water Commission Act specifically authorizes the Division to conduct hydrographic investigations of streams and stream systems and the Division has certain funds appropriated for that purpose. For reasons which have been fully explained in previous reports, there is an extensive demand upon the Division for such work. This work is usually done on a cooperative basis, the interested parties furnishing the bulk of the funds. During the past biennium the Division has received approximately $50,000 for this purpose from outside parties.

A number of areas in various parts of the state have been under investigation during the past two years, those of the greatest importance being on the Kings River, Sacramento and San Joaquin rivers and San Gabriel River. In the southern San Joaquin Valley, from approximately Fresno south to Bakersfield, an intensive study of ground water conditions has been under way for somewhat over a year under the direction of the Kings River water master. This work is covered in Chapter VII hereafter. Also in many, or most, of the areas where the Division has had water masters in charge, a general investigation has been carried along concurrently with the water master work to facilitate improvement in use of water as well as in the water master work itself.

Kings River.

The work of the Division on Kings River was initiated in 1917 and has increased in scope from that time until the present when the water master on this important river not only exercises full control over all diversions but also directs numberous related activities. The Kings River work since its inception has been made a subject of special mention in each of the reports of the Division, and in this volume Chapter VI is devoted to a recital of the developments of the biennium.

San Gabriel River.

While the flow of San Gabriel River is not large, compared to many other streams, it is probable that it is exceeded by none from the standpoint of value of dependent lands and crops. Its water problems are of the most difficult character, subject to all known physical and legal complexities, and to some which were unheard of until recently. The investigation under way by the Division started in 1923 and has cost to date approximately $70,000, the major contributors having been the county of Los Angeles and the city of Pasadena. A progress report on the work is given in Chapter VIII.

Sacramento-San Joaquin Investigation.

In 1924 the threatened shortage of water in the Sacramento Valley for irrigation, navigation and other purposes led to the calling of a general conference on water matters as early as January—this conference being under the auspices of the Division of Water Rights and the Sacramento Chamber of Commerce. The results of the conference were important and permanent. The valuable information and data there presented have been printed as Bulletin No. 3 of the Division of Water Rights, but a more important outcome was the appointment of a Permanent Committee to assist in the solution of Sacramento-San Joaquin River problems. The efforts of this committee during the season of 1924 were mainly directed along two lines: first, to start the collection of records of diversion and use of water, available flow, etc., and, second, to put into effect emergency water conservation measures in order that the shortage would cause the least possible damage. This committee obtained funds to the extent of about $18,000 and requested the Division to direct the work of collecting data and conserving water. Several sections of the 1924 biennial report were devoted to an account of the conference and the work of the committee and of the water supervisor appointed by the Division.

In December, 1924, a second water problems conference was called, at which the results accomplished by the Permanent Committee were submitted. This was also a successful meeting and very effective in bringing together diverse interests to work for a common solution of the great problem. The conference recommended several items of legislation, one of which was that the work initiated by the Permanent Committee, both in collecting data and conserving water, should be continued. The proceedings of the second conference have been printed, together with the water supervisor's report of 1924 as Bulletin No. 4 of the Division of Water Rights.

The work of the water supervisor has been continued through the last two years on much the same lines as described in the earlier report. Another dry year was encountered in 1926, which, however, was not as critical as 1924, due to a number of reasons. The work has been extended and standardized in the light of experience, and it can be definitely stated that the physical data which will be absolutely necessary in the final adjustment of the water question in Sacramento-San Joaquin Valley is being collected in a workmanlike and efficient manner. Since 1924, the cost of the work has been met mainly through a state appropriation.

Chapter IX and Appendices A, B and C describe all phases of the water supervisor's work during the biennial period, the appendices being devoted to the salinity, return water and duty of water studies.

As the greatest value of the records being made available by the Sacramento-San Joaquin investigation lies in their continuity, it is important that the work should be continued for several years on its present basis until such time as the data becomes truly determinative.

Colorado River.

While the Colorado River is the subject of greater interest than any other stream in California today, the activities of the Division of Water Rights in connection with this river have so far not been great. A few applications to appropriate large quantities of water from the Colorado have been filed. Foremost among them are those by the city of Los Angeles proposing to store 1,500,000 acre-feet of water near Parker, Arizona, develop power by means of a 100-foot dam and divert 1500 cubic feet per second by means of conduits and pumping plants to the Los Angeles area for municipal purposes. The city of San Diego has also filed an application for water for municipal purposes from the Colorado River.

Legal Department.

The legal responsibility of the Division has increased along with its other work. Court cases arise from appeals of decisions on applications and in adjudication proceedings. As an adjudication terminates in a court decree, a great deal of legal work is necessary in following the matter through to a satisfactory conclusion. In addition, the opinions and orders of the Division on protested applications often involve legal analyses. There is also a considerable amount of miscellaneous legal assistance at all times necessary in the Division. The legal work has, in fact, increased to a point where it is a question of some difficulty. A statement of all the court cases in which the Division is involved is given in Chapter V.

Several cases have been concluded by decree of the court within the last two years with the beneficial result of interpreting many hitherto doubtful points in the Water Commission Act. As noted earlier on account of a heritage from the past, the Water Commission Act was in some respects on doubtful ground. Some of these points have been clarified by amendments and others by court decision. It is to be hoped that the pending cases will result in further clarification which can not fail to be of assistance to the Division.

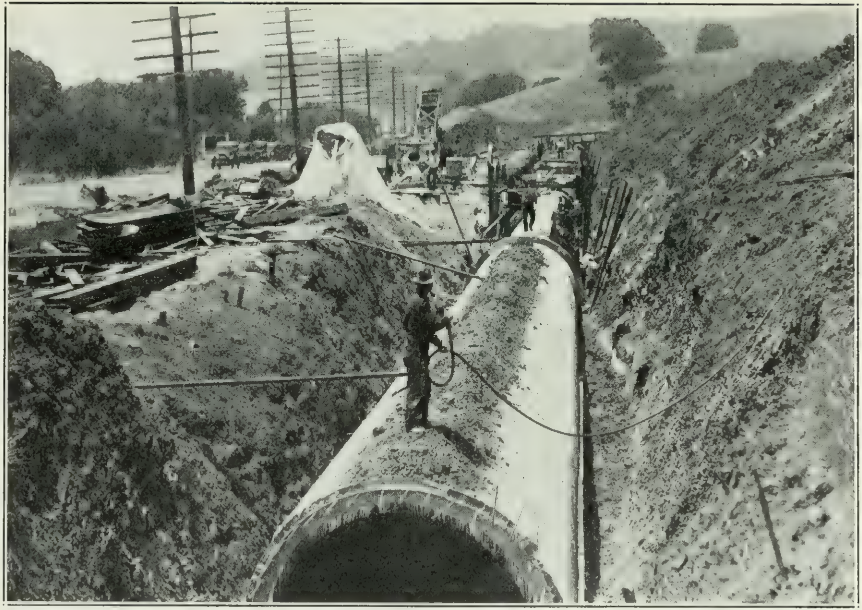
New Legal Problems.

Within the last few years the development of modern projects has raised questions of water law on which not any or very little light can be found either in previous water law history, court decision or the Water Commission Act. One such important question at this time revolves about the ownership of water released from storage and abandoned by the original appropriators. Reservoirs have been constructed for power purposes and the winter waters stored therein returned to the streams later in the year, after having been used to generate electric energy. This increases the flow of such streams at a time when there is a great demand for water by irrigators in the valleys below. To whom does such water belong? Can the power company dispose of it by contract? Does it inure to the benefit of prior appropriators in the order of their priority, or in order of their position on the stream? Or does it go to the later appropriator who files on this particular water? California decisions do not cover these points and the other irrigation states do not seem to have any clear precedent. However, an answer to these questions must be had in the relatively near future, and must come in the first instance from the Division.

In this connection it is also contended by riparian owners that such released waters accrue to them under their riparian rights, which brings up the question as to whether or not riparian owners who have not used water have estopped themselves to claim rights therein as in effect provided in Section 11 of the Water Commission Act. This section, it will be recalled, provides that in so far as waters have not been applied to beneficial use on riparian lands for ten consecutive years they are deemed by conclusive presumption not to be needed for use thereon and shall be opened to appropriation if not otherwise appropriated. While there has been some question as to the constitutionality of such a measure, apparently no one has seen fit to take the matter to court for a judicial determination. The Division in the meanwhile has been operating under this section and will continue to do so unless or until the situation is changed by court decree.

Herminghaus v. Southern California Edison Co.

This case is receiving more attention than any water litigation since the famous *Lux* v. *Haggin* decision in 1886. The Herminghaus case is



WATER SUPPLY CONDUIT OF EAST BAY MUNICIPAL UTILITY DISTRICT.

This concrete and steel conduit will eventually deliver a municipal water supply from Mokelumne River to the East Bay Municipal Utility District under permit from the Division of Water Rights.

PLATE 6.

an attempt on the part of a lower riparian owner to secure an injunction on account of the alleged infringement of riparian rights by the upper storage of water by the Southern California Edison Company, a power concern. The case involves the rights of a defendant claiming both as an upper riparian and an upper appropriator and due to the importance of the right under which waters may be stored as against lower riparian objections. A brief was filed by the State and the Department of Public Works and the Division of Water Rights in the exposition of the interests of the people that the riparian right should not be held to attach to all the water and that storages should be allowed only under the doctrine of appropriation.

On account of the great public interest in this case as well as the importance of the points involved, it has been the hope of those connected with water matters that the Supreme Court decision when issued will clear up many of the difficult points which have long been in doubt.

Cooperation with United States Government.

Complete and effective cooperation with the different branches of the federal government has been carried on during the past two years in the same manner as outlined in the 1924 biennial report. Appendix A of that report contained a statement from the supervising officer of each of the departments with which the Division of Water Rights had important cooperation as follows: The Geological Survey, The Department of Agriculture, The Forest Service, The Power Commission and The War Department. As the situation at the present is practically identical with what it was at that time, reference is made to the full discussion in this earlier account of the points of contact between the Division of Water Rights and these five United States Departments, the mutuality of interest and the methods of cooperation which have been evolved and the benefits derived therefrom.

In the case of the Water Resources Branch of the United States Geological Survey there is an actual financial contribution by the Division for work under the supervision of the federal office. This appropriation was made by a special act of the legislature (Chapter 190–1925) and consists of $20,000 for the fiscal years 1925 to 1927. A report by the Survey on the work carried on under this appropriation is contained in Appendix D.

Financial Statement.

Chapter X contains a financial statement of the Division for the seventy-sixth and seventy-seventh fiscal years extending from July 1, 1924, to June 30, 1926, inclusive. This report shows that the work during these two years was carried forward under eight legislative appropriations and ten contributive funds. The total expenditure from state funds was $199,075.99, from the adjudication revolving fund $16,239.40, and from contributive funds $57,053.04. Fees collected during these two years and credited to the general state fund amounted to $58,759.76, which is nearly double the amount so collected in any previous two-year period.

Los Angeles and Fresno Offices.

The Division maintains branch offices at 1025 Sun Finance Building, Los Angeles and 1302 Pacific-Southwest Building, Fresno. The

Los Angeles office is maintained jointly by the three divisions of the Department of Public Works and is used by the Division of Water Rights mainly for the conducting of hearings affecting Southern California water matters and to give out information to applicants and other interested parties. A supply of application blanks, rules and regulations, forms and miscellaneous publications is kept on hand and is at all times available. The office is under the direction of the hydraulic engineer of the Division in charge of the San Gabriel River investigation. Inasmuch as approximately one-third of the applications to appropriate water come from Southern California there is a pressing demand that the Los Angeles office of the Division be increased in size and effectiveness.

The Fresno office is maintained by the Kings River water master in connection with his other duties and is used mainly as a source of information to the public.

Publications.

During the last two years there have been a number of reports issued by the Division. Two such reports have been printed and made available for public distribution. These are Bulletin No. 4, "Proceedings of the Second Sacramento-San Joaquin River Problems Conference and Water Supervisor's Report, 1924," and Bulletin No. 5, "San Gabriel River Investigation, 1926." A number of other engineering or referee's reports have been issued which are publicly available at the office of the Division but which were not printed and are not available for distribution. The principal ones are Division reports as referee on Owl, Soldier and Morrison creeks, the Kings River Water Master Statements for 1924 and 1925, the Sacramento-San Joaquin Water Supervisor's Report for 1925, several water master reports on streams in northern California for 1924, 1925 and 1926, and the engineering compilations in connection with the Shasta River adjudication.

Other printed publications available for distribution include the abstract of claims in the Whitewater and Shasta River adjudications and the Water Commission Act and Rules and Regulations. The act has been amended so many times that it is difficult to follow it in its present form through the usual statutes. As compiled and printed in pamphlet form, however, it is in usable shape.

Public Interest in Water Questions.

The great and increased public interest in water matters in California can not be denied. The work of the Division has steadily increased over the past several years and will apparently further increase in the future. Shortage of water for areas actually under cultivation has made the question of conservation of water foremost in these areas and one of statewide importance. This has resulted in the introduction of bills in the legislature to accomplish specific or general purposes. One such bill worthy of mention is that which would reserve to the agricultural areas in the mountain counties of the state where development will be very slow a certain percentage of the waters of the streams which originate in said counties. While the underlying justice of such an idea is generally admitted, the difficulty of devising a workable plan to put it into effect has so far been too great to overcome.

The office of the Division of Water Rights has operated the Water Commission Act for the past twelve years and has studied previous water law history and the Supreme Court decrees in that connection, and while at this time the Division is not advancing specific recommendations for the improvement of the water law situation, it will be glad to comment upon or constructively criticise measures advanced by others.

TABLE 2.

Summary of Proposed Agricultural and Power Development by Counties as Shown by Applications Received and Permits Issued During Biennial Period Ending September, 1, 1926.

County	Applications received (proposed developments)			Permits issued		
	Number	Acres to be irrigated	Theoretical horsepower to be developed	Number	Acres irrigated	Theoretical horsepower
Alameda	3	130		3	69	
Alpine	2		4,933	2	930	
Amador	9		39,757	10	664	50,800
Butte	35	70,015	26,576	37	62,977	16,186
Calaveras	15	748	26,459	13	109,200	77,245
Colusa	3	3,051		6	32,451	
Contra Costa	3	3,632		4	3,508	
Del Norte	6	27	60	2	80	
El Dorado	43	367	186,137	40	616	53,322
Fresno	2		202,500	4		232,613
Glenn	12	3,663		13	22,333	
Humboldt	24	649	376	18	577	96
Imperial	2			4	50	
Inyo	42	1,710	12,186	19	2,848	200
Kern	10	143		6	96	
Kings	2	195,073				
Lake	4	1,073	7,045	4	1,123	
Lassen	5	15,384		4	6,563	
Los Angeles	72	32,042		60	3,749	
Madera	4	325		5	311	15
Marin	4	826		2	40	
Mariposa	2	350				
Mendocino	13	5,968	14,636	13	1,184	
Merced	1	225		1	94	
Modoc	4	401	1	14	1,685	1
Mono	11		20,058	10	24	2,016
Monterey	2	68		2	2	
Napa	4	15,440		3	140	
Nevada	7	30	59,225	13	154,495	15,603
Orange	2	6,000		2		
Placer	13	79,357	35,485	8	1,515	
Plumas	30	85	249,296	27	95	119,381
Riverside	21	880	30	19	1,343	
Sacramento	14	24,738		11	6,055	
San Benito	1	1,000		2	222	
San Bernardino	80	55,634		100	54,715	
San Diego	25	65,902		26	3,164	51
San Joaquin	59	63,731		25	50,308	
San Luis Obispo	4	352		8	655	
San Mateo	3	2,770				
Santa Barbara	16	35,998		11	2,454	
Santa Clara	3	1,120		3	60	
Santa Cruz	9	11	743	3	134	
Shasta	15	19,461	14,528	10	185	
Sierra	15		789	14		281
Siskiyou	28	17,790	8	32	40,994	
Solano	4	56,447		6	41,975	
Sonoma	2	15		3	60	
Stanislaus	5	2,731		12	40,381	
Sutter	8	6,769		16	9,569	
Tehama	4	603	127,129	7	1,525	28,956
Trinity	16	22,196	80,248	18	397	5,433
Tulare	11	19,745	1,057	10	6	1,237
Tuolumne	8	21	81,397	8	109,021	26,819
Ventura	20	22,011	82,478	5	212	
Yolo	24	55,771		32	41,738	
Yuba	10	74,744	34,623	7	7,147	5,305
*State of Nevada	2	31,000		6	162,000	

*To be diverted in California and used in Nevada.

Applications cancelled and permits revoked before December 1, 1926, and duplications in acreage and horsepower are not listed.

For information relative to mining and municipal projects see tables 28, 29, 32 and 33.

CHAPTER II.

SUPERVISION OF THE APPROPRIATION OF WATER.

Supervision of the appropriation of water in California is placed in the hands of the Division of Water Rights by what is known as the Water Commission Act (Chap. 586 Stats. 1913 as amended). The three main objectives of this supervision are (a) to work out a clear definition of the project and the needs of the prospective appropriator, (b) to give such notice thereof as will enable the prospective appropriator and the owners of prior vested rights to work out the relation of the proposed appropriation to prior rights vested in the source, and (c) to maintain a complete and up to date record of the status of all appropriative rights initiated under the provisions of the Water Commission Act. This law went into effect on December 19, 1914, and the procedure which has been developed for its administration together with an account of the activity of this office in that connection are set forth in the following named earlier reports to which reference is made:

Third Biennial Report of the State Water Commission—Chapter II.
Fourth Biennial Report of the Division of Water Rights—Chapter II.
Fifth Biennial Report of the Division of Water Rights—Chapter III.

Activity During Past Biennial Period.

The work of the Division during the past biennial period in connection with supervision of the appropriation of water is shown by tabular summaries in Tables 1, 2, and 3, and graphically by Plates 3, 7, 7A, 8, 8A, 9 and 9A. Tables 26 to 33, inclusive, at the end of this report, list according to the purpose the more important applications received and permits issued. There has also been compiled a tabular summary not printed in this report which shows—by six-month periods and by cumulative totals at the close of each six-month period—the action taken upon the several classes of applications, *i. e.* agricultural, power, mining, etc.

During the past biennial period 1001 applications were received, 793 permits were issued, and 429 applications were cancelled. The number of pending applications (*i. e.* applications awaiting action) was reduced therefore by 221 or from 885 to 664. These figures, it is believed, are particularly significant in that they indicate ability on the part of the Division to act promptly upon applications and thus avoid unnecessary delay to applicants. For the first time since the inception of the office the Division has, in recent months, found itself in a position to act promptly upon applications as rapidly as they were placed by the applicants in readiness for action, except of course in a few isolated cases where an extended study of water supply and prior rights was first necessary to settle the question of the availability of unappropriated water.

Inspection of the tables and graphs referred to above discloses the fact that only approximately 43 per cent of the applications received are approved and of those approved only approximately one-half ever receive a license. It is further noted that of each 100 cubic feet per second direct diversion, or natural flow, applied for only 16 second-feet are allowed and the right to appropriate less than 7 second-feet is finally confirmed through the issuance of a license; also that of each 100 acre-feet of storage applied for only approximately 7 acre-feet are allowed and the right to appropriate less than 0.6 acre-foot is finally confirmed through the issuance of a license. These figures again are taken to be very significant in that they indicate that for one reason or another appropriators finally consummate rights to only 7 per cent of the natural flow and less than 1 per cent of the storage for which application is made, and that the supervision of appropriation carried on by the Division is effective in weeding out the excess, thus clearing the way for subsequent appropriators.

TABLE 3.

Statistical Summary Relative to Field Investigations.

Item	*1925*	*1926*
Total number of new cases referred for field investigation	340	351
Total number of cases investigated, including carry-over (Inspected by Field Force)	378*	386*
Number of permit and license inspections	396	376
Number of cases investigated other than permit or license inspections	41	36
Number of cases investigated per man-day in field	1.18	1.28
Miles traveled per man-day in field	78	72
Miles traveled per case investigated	66	55
Per cent of total time spent in field work	35%	35%
Cost of actual field work per case investigated	$15.75	$14.80
Cost of office work per case investigated	$10.40	$10.15
Total cost of field and office work per case investigated	$26.15	$24.95

* 85 additional cases for which no data as to time, mileage and cost are available were inspected during the biennium by the Alhambra office and the office of the Sacramento-San Joaquin Water Supervisor in connection with the investigational work carried on by those two offices.

The increased filing fee schedule enacted by the legislature in 1923 has played an important part in eliminating many purely speculative filings thus assisting materially in the reduction of pending cases. While the present schedule of filing fees would appear to work no great hardship on bona fide appropriators because it is such an altogether insignificant portion of the total cost of a water resource development it does present quite an obstacle to those purely speculative projects where filings are made merely in the expectation of thus securing a priority which can later be sold to someone else who desires to undertake the development in good faith. During the past biennium the increased fee schedule has eliminated 61 applications for a total of more than 15,000 cubic feet per second of natural flow and 3,600,000 acre-feet of storage upon which additional filing fees in the sum of approximately $27,700 were due. In addition to this the increase in filing fees has produced during the period September 1, 1924, to August 31, 1926, a revenue of $31,371.30 in excess of that which would have been returned under the schedule of fees previously in effect.

Section 1*a* which provides for the holding of hearings upon protested applications was added by way of amendment to the Water Commission Act at the legislative session in 1923. The procedure which was adopted by the Division as a result of this amendment has facilitated action upon contested cases with no perceptible increase in cost. During the past biennium 100 hearings have been held in 21 counties of the state upon 234 different applications which were variously protested by from one to approximately 300 protestants and the length of time required to hear the various cases varied from a few minutes up to 16 days, one case resulting in the taking of 2040 pages of transcript. Most of the

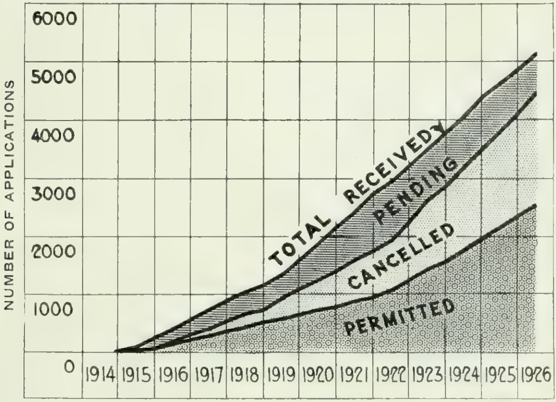
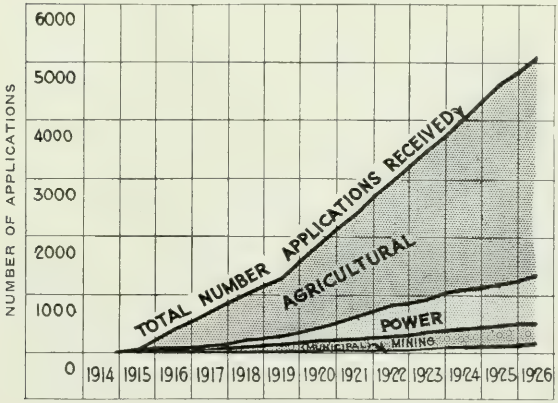

APPLICATIONS RECEIVED AND ACTIONS SHOWN BY CUMULATIVE TOTALS

PLATE 7.


APPLICATIONS RECEIVED

SHOWING RELATIVE NUMBERS FOR VARIOUS USES

Agricultural - - Power - - Mining - - Municipal

PLATE 7A.

hearings were presided over by the Chief of Division, but in those cases where he was unable to attend another member of the staff was appointed examiner to act for him under the provisions of section 7 of the Water Commission Act, as amended at the 1925 session of the legislature.

Hearings upon protests have been substituted in a large measure for field investigations with an attendant decrease in the cost of field work. Prior to 1924, when the hearing procedure became effective, approximately 35 per cent of all cases referred for field investigation were so referred on account of protests. During the past biennium only 2½ per cent of the cases were referred on account of protests.

In Table 3 there is given a statistical summary of facts concerning field investigations. This table indicates an increase in the number of cases investigated per man-day in the field and a decrease in the cost per investigation which is due to careful planning of field work and a thoroughly trained personnel. During the past biennium the number of pending permits and licenses has increased, however, from 1393 to 1982 or 42 per cent and as each permit requires at least one inspection before license, and each license an occasional inspection in order to maintain a complete record of the status of the water right covered thereby, it becomes at once apparent there must be again an increase in the amount of field work and this increase will continue thereafter from year to year.

As a result of the 1426 actions taken during the biennium upon applications, permits and licenses, appeals on five different actions have been taken to the superior court. These cases are:

Coronado Water Company vs. *Department of Public Works et al.* (San Diego Co.)

Van Dyke vs. *Department of Public Works et al.* (San Bernardino Co.)

Yuba River Power Company vs. *State Department of Public Works et al.* (Nevada Co.)

Preston vs. *Department of Public Works et al.* (Amador Co.)

California Delta Farms, Inc., et al. vs. *East Bay Municipal Utility District et al.* (Amador Co.)

The court action on none of these cases is yet terminated but a discussion of the legal phases of the matter will be found in Chapter V of this report.

Amendments to the Water Commission Act Passed in 1925.

The Water Commission Act was amended in certain particulars at the 1925 session of the legislature, largely for the purpose of codifying what had been the past practice of the Division.

Section 7 was amended to provide that the chief clerk might certify the records of the Division thereby relieving the Chief of Division of much routine detail and placing the responsibility for such work where it properly belonged. By a further amendment to this section it was provided that the Chief of Division might designate members of the staff to act as examiners and conduct hearings.

Section 10*a* was added to the act expressly providing that the Division may conduct investigations of streams, stream systems, lakes, or other

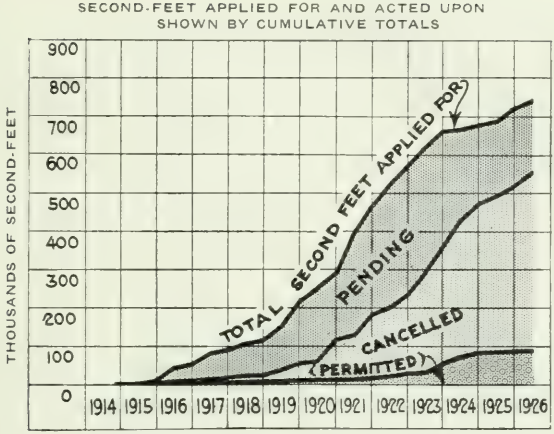


PLATE 8.

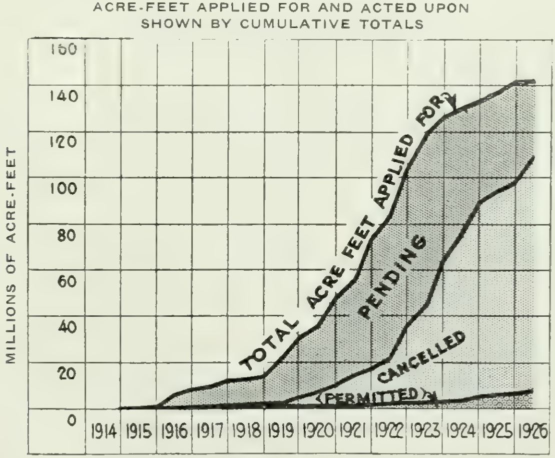


PLATE 8A.

bodies of water, investigate either or both surface and underground water conditions, collect records of diversion and use of water, supervise the distribution of water in accordance with agreements therefor, and do all or any of such work either independently or in cooperation with individuals, firms, associations, corporations, or other agencies including county, state and federal agencies. An account of the investigational work and supervision of distribution of water carried on under the provisions of this amendment will be found elsewhere in this report.

Section 16 was amended by the addition of clauses which,

> (a) Exempted underground storage applications from the requirement that height of dam and reservoir capacity must be shown.
>
> (b) Required that notice must be given of an application for permit to appropriate.
>
> (c) Made provision for receipt of protests.
>
> (d) Made provision for hearings upon protested applications.

This section was also amended to correct somewhat the inconsistencies and uncertainties previously existing in the matter of advertisement and action upon petitions to change point of diversion and place of use.

Section 17 was amended to eliminate the provision requiring that a copy of the permit be filed in the office of the recorder of the county or counties wherein diversion is to be made, and as will be noted later a provision was added by amendment to section 19 that a copy of each license and all orders affecting licenses should be filed in the office of the recorder of the county or counties where diversion and use are made. Section 17 was also amended to make revocation the penalty unless permit fees were paid within thirty days after receipt by permittee of notice of issuance of the permit.

Section 18 was amended to allow extensions of time for beginning of construction and application of water to beneficial use upon showing of good and sufficient cause and further to provide not only that construction work under permit shall be diligently prosecuted but also that the water appropriated shall be diligently applied to beneficial use.

Section 19 was amended to make beneficial use a prerequisite to the issuance of a license, thus following out the principle of the amendment to section 18 just noted. While the Division had previously been governed by this principle it was desirable that the law be made clear upon the point that license could be issued only for such an amount of water as had been put to beneficial use.

As heretofore noted this section was also amended to include a provision that a copy of each license and any order amending, revoking, or otherwise affecting the same should be filed promptly in the office of the recorder of the county or counties wherein diversion and use are made. This, it is believed, is a most important amendment because it establishes in each county a complete record of the status of all rights to appropriate water initiated subsequent to December 19, 1914, as soon as such rights are confirmed by the issuance of a license. Under the law previously in effect nothing was done to maintain a complete record of the status of the permits filed in the office of the county

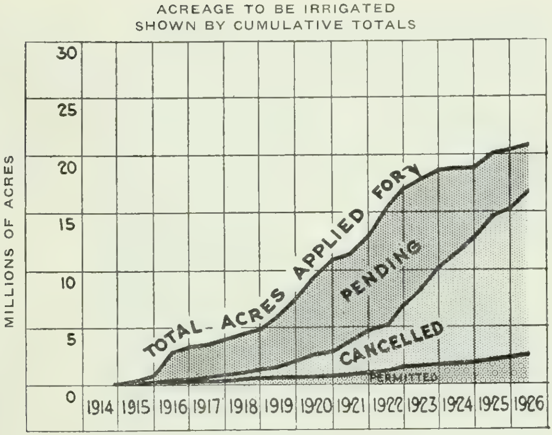


PLATE 9.

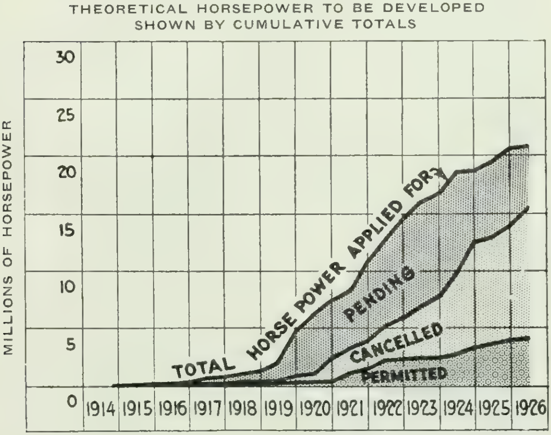


PLATE 9A.

recorder. Although many of the permits were subsequently amended and all were eventually either revoked or superseded by license the record in the office of the county recorder remained unchanged.

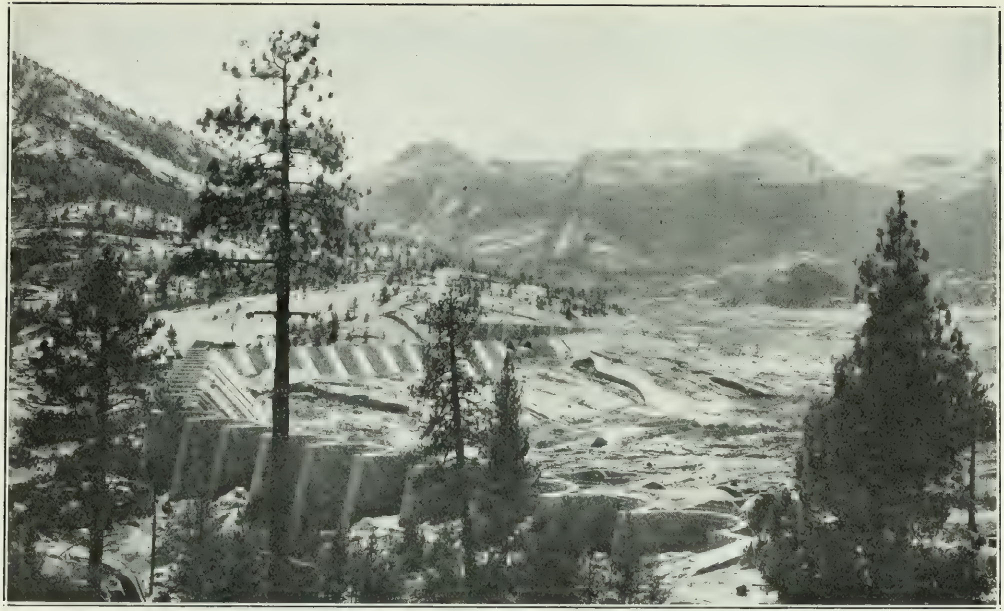
Section 39 was amended to clear up the ambiguity previously existing therein relative to the jurisdiction of the Division of Water Rights in the matter of changes in character of use. The amendment specifically limits the jurisdiction of the Division to changes in purpose of use of water acquired under the Water Commission Act and provides that such changes may be allowed upon petition to the Division providing petitioner first establishes to the satisfaction of the Division that intervening appropriators and legal users of water are not injured thereby.

Many Important Developments Proceed Under Permit.

Applications covering many important developments have received approval during the past biennium and the projects are now proceeding under permits of the Division.

Perhaps the most notable among these is the municipal water supply development of the East Bay Municipal Utility District on Mokelumne River. This project involves the construction of a concrete arch dam 345 feet in height on Mokelumne River near Lancha Plana thereby creating a storage capacity of 217,000 acre feet and providing a regulated flow of 310 cubic feet per second into the conduit lines leading to the District which embraces the cities and towns of Oakland, Alameda, Berkeley, San Leandro, Emeryville, Piedmont, Albany, Richmond and El Cerrito. The estimated cost of the project is $80,000,000 and construction is now actively under way. This is the largest municipal water supply project yet to receive permit from the Division.

Numerous agricultural projects of considerable magnitude and importance to the state at large have received permits also during the past biennium. Among these are the Yuba River and South Wolf Creek developments of Nevada Irrigation District in Nevada County, the Melones storage development of Oakdale and South San Joaquin Irrigation districts in Stanislaus and San Joaquin counties, the Concow storage development of Thermalito and Table Mountain Irrigation districts in Butte County, the additional storage and direct diversion developments on Little Butte Creek and West Branch of Feather River by Paradise Irrigation District in Butte County, the Lost Creek development of Oroville Wyandotte Irrigation District in Butte County, the Shasta River and Parks Creek development of Montague Irrigation District in Siskiyou County, the Stoney Creek storage development of the Orland Project of the U. S. Bureau of Reclamation in Glenn County, the storage development on East Walker and West Walker Rivers in Nevada, the Mojave River storage development of the Mojave River Irrigation District in Riverside County and the underground storage development of the Water Conservation Association in San Bernardino County. It is interesting to note in passing that of the amounts allowed during the past biennium 78 per cent of the direct diversion and 88 per cent of the storage was to irrigation districts, mutual water companies, etc., and thus represented what might be called clearly public or community developments.



FLORENCE LAKE DAM ON SOUTH FORK OF SAN JOAQUIN RIVER.

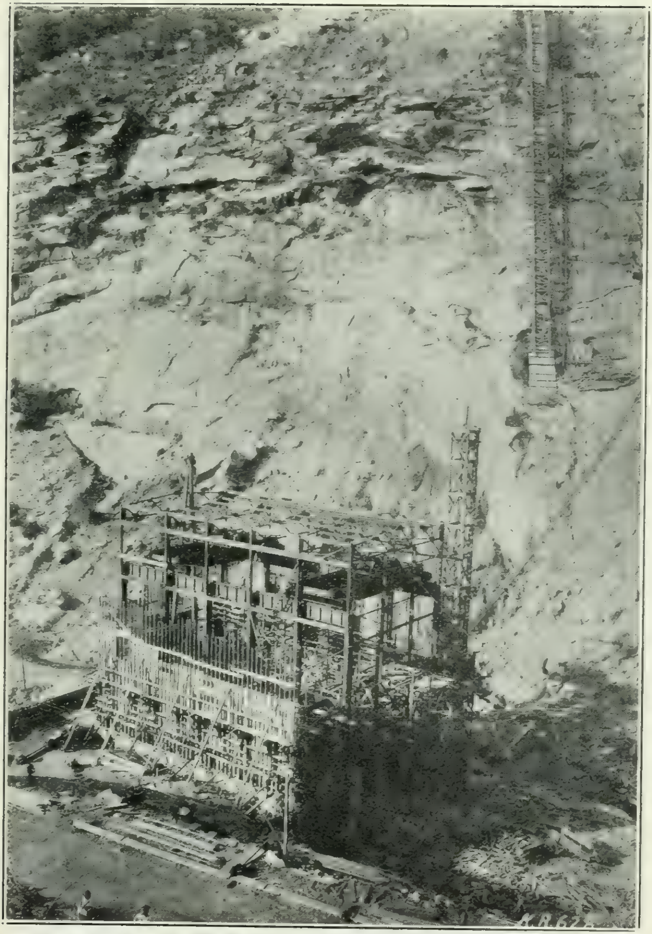
Completed in 1926 by Southern California Edison Company under Application 1344. Capacity 43,224 acre-feet. Surface elevation 7305 feet. Water stored here will be dropped through five power houses and returned to San Joaquin River at an elevation of 1000 feet at a point approximately twenty miles upstream from Friant.

PLATE 10.

Notable among the power developments which have received permit during the past biennium are those of the Pacific Gas and Electric Company on Clear Creek and West Branch of North Fork of Feather River in Butte County and on Cole and Beaver creeks, Bear River and North Fork of Mokelumne River in Amador County, the Spaulding Rim development of Nevada Irrigation District and Pacific Gas and Electric Company on Yuba River in Nevada County, the Melones development of Oakdale and South San Joaquin Irrigation districts and Sierra and San Francisco Power Company on Stanislaus River in Calaveras and Tuolumne counties, the Bucks Creek development of Feather River Power Company in Plumas County, the Silver Fork of American River development of El Dorado Power Company and Western States Gas and Electric Company in El Dorado County, the Kings River direct flow developments of the San Joaquin Light and Power Corporation on Kings River in Fresno County, and the combined mining and power development of James B. Knight and others on New River in Trinity County.

The rapid increase in the installed capacity of California hydro-electric generating stations is indeed remarkable. Beginning in 1890 with a small station at Pomona the installed capacity of California stations had increased to roughly 125,000 horsepower in 1907, 1,150,000 horsepower in 1921, 1,450,000 horsepower in 1924, and 1,850,000 in 1926. California—for years second to New York in developed water power—now leads all other states.

Permits were issued by the Division during the past biennial period for direct diversion and storage with which to operate or supplement the supply of hydro-electric plants having a capacity of 1,143,426 theoretical horsepower. This brought the total allowed by the Division on September 1, 1926, up to 4,506,708 theoretical horsepower and is more than allowed in any previous similar length of time except that from September 1, 1920, to September 1, 1922, when 1,983,839 theoretical horsepower were allowed. The great development in the preceding period is to be accounted for by the fact that hydro-electric developments prior to that time had been held up by two things—war conditions and difficulties in securing necessary easements upon government lands. Relief from war conditions and the creation of the Federal Power Commission, which became active in June, 1920, opened the way for an immediate and extraordinary hydro-electric development which will perhaps not soon be surpassed. The significance of these figures as to development during the 36 years which have passed since the first hydro-electric installation in California becomes at once apparent when one pauses to reflect that the potential water power resources in California are estimated at only approximately 4,600,000 horsepower available 80 per cent of the time or 6,700,000 horsepower available 50 per cent of the time.



BALCH POWER HOUSE.

In process of construction by San Joaquin Light and Power Corporation on Kings River.
Head 2475 feet. Theoretical horsepower 202,500.

PLATE 11.

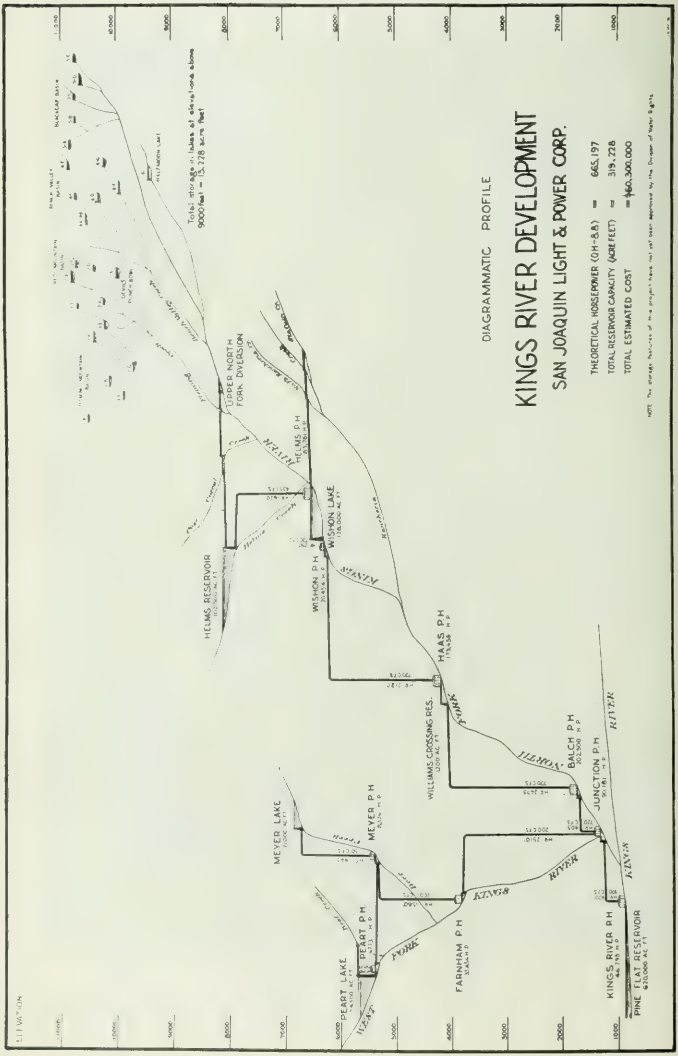

DIAGRAMMATIC PROFILE
KINGS RIVER DEVELOPMENT
SAN JOAQUIN LIGHT & POWER CORP.
THEORETICAL HORSEPOWER (QH÷8.8) = 665,197
TOTAL RESERVOIR CAPACITY (ACRE FEET) = 319,228
TOTAL ESTIMATED COST = $60,300,000
NOTE The storage features of this project have not yet been approved by the Division of Water Rights
ELEVATION
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
Total storage in lakes at elevations above 9000 feet = 13,228 acre feet
BLACKCAP BASIN
HALFMOON LAKE
DEVILS PUNCH BOWL
UPPER NORTH FORK DIVERSION
HELMS P.H.
63,761 H.P.
HELMS RESERVOIR
WISHON LAKE
128,000 AC FT
WISHON P.H.
HAAS P.H.
WILLIAMS CROSSING RES.
1200 AC FT
BALCH P.H.
202,500 H.P.
JUNCTION P.H.
90,181 H.P.
MEYER LAKE
21,000 AC FT
MEYER P.H.
PEART LAKE
PEART P.H.
FARNHAM P.H.
KINGS RIVER P.H.
46,793 H.P.
PINE FLAT RESERVOIR
670,000 AC FT
NORTH FORK
KINGS RIVER
WEST FORK
Rancheria Creek
Helms Creek
Dinkey Creek
770 C.F.S.
200 C.F.S.

PLATE 12.

CHAPTER III.

ADJUDICATION OF EXISTING WATER RIGHTS.

The conditions that necessitated the enactment of the provisions of the Water Commission Act pertaining to the adjudication of existing water rights by stream systems have been fully discussed in the earlier biennial reports of the Division of Water Rights, and of its predecessor, the State Water Commission. It is thought that the necessity for such legislation has been particularly well explained in the introduction of Chapter IV of the Biennial Report of the Division published November 1, 1924.

Titles to the use of water must be established and made secure in order to insure an orderly, systematic and judicious development of the water resources of the state. The adjudication procedures provided in the Water Commission Act afford the means by which existing water rights on any stream system may be determined and placed of record in a single proceeding, to the end that they may be protected from infringement by new rights that may be acquired, and that they may be made the basis for distribution by water master whenever it becomes necessary that such control be exercised.

Under the provisions of the Water Commission Act, adjudication proceedings may be initiated in advance of conflict between water users and, by settlement of the rights involved, the owners of vested rights may secure protection from actual injury due to diversion by junior upstream users, and from litigation that might otherwise be instituted by downstream users.

Where adjudication proceedings are conducted by the Division of Water Rights a complete and thorough investigation and survey of the entire stream system is made by specially trained engineers who are state employees and disinterested parties. Such investigation and survey include measurements of the water supply and of the amounts of water used under the various diversion systems, and in the case of irrigation rights measurements of the areas irrigated and a study of the various factors upon which the duty of water is based. The physical facts are thus determined and presented in the form of maps, tabulations, and reports, and most of the historical facts are determined by a simple and effective procedure through the medium of written statements of claims or, if necessary, by evidence taken at hearings held at a place convenient to the claimants and witnesses. With all of the data and information above mentioned at hand it is then possible to apply the law and make an accurate determination of the rights involved.

Sections 24 to 36*f*, inclusive, of the Water Commission Act, as amended in 1917, provide two procedures under which the Division of Water Rights may determine existing water rights upon any stream system, the findings of the Division in both procedures being subject to confirmation or modification by superior court decree.

Adjudication Procedure—Sections 25 to 36f of Act.

Adjudication proceedings under sections 25 to 36*f*, inclusive, of the act may be initiated by the filing of a petition signed by one or more claimants followed by a finding by the Division that the facts and conditions are such as to justify the proceedings, or they may be initiated by action of the Division on its own initiative. An order is then entered by the Division designating the stream system to be investigated; notice is published; a thorough field investigation and compilation of data is made by Division engineers; notice is published setting a date on or before which proofs must be filed by claimants; forms for proofs are supplied by the Division; claimants are assisted in utilizing the data collected by the Division if they so desire; the proofs are assembled, abstracted, and submitted to public inspection together with all data and maps compiled and prepared by the Division; claimants are given opportunity to contest any proof or proofs; contests are conducted at hearings; an order of determination is entered; the order of determination is printed and a certified copy is filed with the clerk of the superior court in the jurisdiction wherein the investigation is made; an order from the court setting a date for hearing is obtained; notice of such hearing is published and served by registered mail; any time at least ten days prior to date of hearing parties aggrieved may file a notice of exceptions to the order and thereby secure a hearing in court and a determination made by the court. In case no exceptions are filed the court enters the order of determination filed by the Division, as its decree. By such procedure all water rights by appropriation upon any stream system may be determined, and on stream systems where riparian and prescriptive rights are not involved to any considerable extent a comprehensive determination may be obtained by this method.

Court Reference Procedure—Section 24 of Act.

Under the provisions of Section 24 of the Act any suit pending in the superior court in which the determination of water rights is involved may be referred to the Division of Water Rights for investigation as referee. In order to secure such a reference a suit must be filed in the superior court and an order of reference obtained from the court. Such a suit may be prompted by actual conflict between parties or it may be of a friendly nature and primarily intended to secure a settlement of rights by this method of procedure. The reference to the Division is discretionary with the court. Many such cases have heretofore been so referred either by stipulation of the parties or by unopposed motion. In order to secure a complete adjudication on any stream system by the court reference method the pleadings should be so framed as to call for a determination of the relative rights of all parties using water and not simply for the determination of the rights of a plaintiff group as against a defendant group. In other words the pleadings should not be limited in scope so as to prevent a decree which will establish the right of each party as against every other party to the proceedings. Also the pleadings should be ruled upon by the court prior to the order of reference and the issues thereby defined and joined.

An order of reference having been received by the Division the procedure followed is in some respects similar to that outlined in the case of proceedings under sections 25 to 36*f* of the act. However the Division is not bound by any formal procedure in a court reference

BURNEY FALLS ON BURNEY CREEK, SHASTA COUNTY.

A stream on which the rights to use water have been determined, and diversions are regulated by the Division of Water Rights under the provisions of the Water Commission Act.

PLATE 13.

and any of the various steps provided for in sections 25 to 36*f* may be eliminated or modified as conditions may justify, although a hearing before the Division as referee is held in case the parties are not brought into agreement, and upon such points as the parties will not settle by stipulation. In general, the pleadings filed by the parties in court reference proceedings will take the place of proofs of appropriation, and the Division, after having compiled data and made surveys and maps covering the physical facts involved, and having held such conferences with the parties and such hearings as may have been necessary, and having thereby fully informed itself in the premises, files its report as referee, which report includes findings of fact, conclusions of law, and a proposed judgment and decree. Any parties dissatisfied with the referee's report are entitled to be heard in court, and the findings of the Division may be modified by the court in its decree as evidence submitted by any dissatisfied parties may justify.

Under the court reference procedure above described all water rights of whatsoever character may be included, and it is the only means by which riparian and prescriptive rights may be brought before the Division of Water Rights for determination. On all stream systems where riparian and prescriptive rights are involved to any considerable extent, the court reference procedure should therefore be resorted to rather than the procedure provided in sections 25 to 36*f*, inclusive, of the act, which latter procedure is specifically limited to water rights by appropriation.

Adjudication Proceedings Undertaken.

Eighteen adjudication proceedings have been undertaken by the Division of Water Rights and by its predecessor, the State Water Commission, either under court reference as provided for in Section 24 of the act, or under the provision of sections 25 to 36*f*, inclusive, of the act, as summarized in Table 4, on the opposite page.

It will be noted that seven of the proceedings have been successfully terminated by court decrees, that one was abandoned because of legal complications, and that ten are still pending. The seven completed proceedings have resulted in the establishment of 161 water rights, covering a total direct flow diversion equivalent to a continuous flow of approximately 339 cubic feet per second, and storage diversion to the extent of 3987 acre-feet per annum. Of the total direct flow diversion decreed, approximately 306 cubic feet per second are for use for agricultural purposes on approximately 13,570 acres of land, 11 cubic feet per second are for use for developing power, and 2 cubic feet per second are for use for mining purposes. The entire quantity of water decreed for diversion to storage is to be used for the irrigation of approximately 1,900 acres, making a total area of approximately 15,470 acres of irrigated land to which water rights were decreed in the seven proceedings.

Adjudication Proceedings Completed During Biennium.

One such proceeding was terminated by court decree during the biennium ending November 1, 1926, this being the Burney Creek reference.

TABLE 4.

Summary of Adjudication Proceedings.

Stream system	Location, counties	Method	Date of order initiating	Status Nov. 1, 1926	Remarks
Red Rock Creek.	Lassen	Court reference.	May 27, 1916.	Closed	Case failed of completion because of involved land ownerships and other pending litigation.
Willow Creek	Lassen	Court reference.	June 12, 1916.	Completed.	Decree entered April 16, 1918.
Stanislaus River.	Alpine, Calaveras, Tuolumne, Stanislaus and San Joaquin.	Sections 25 to 36*f*.	Aug. 24, 1917.	Pending	Final order of determination filed in Superior Court; exceptions to order filed; court hearing on exceptions pending.
San Pedro Creek.	San Mateo	Court reference.	Sept. 6, 1917.	Completed	Decree entered May 12, 1921.
North Fork Cottonwood Creek.	Shasta	Court reference.	June 9, 1919.	Completed	Decree entered June 9, 1920.
West Fork Carson River.	Alpine	Sections 25 to 36*f*.	June 23, 1919.	Completed	Decree entered November 29, 1921.
Hat Creek	Shasta	Court reference.	Mar. 29, 1920.	Completed	Decree entered May 14, 1924.
Oak Creek	Inyo	Sections 25 to 36*f*.	Sept. 26, 1921.	Completed	Decree entered June 17, 1924.
Burney Creek	Shasta	Court reference.	Nov. 25, 1921.	Completed	Decree entered January 30, 1926.
Shasta River	Siskiyou	Sections 25 to 36*f*.	Dec. 21, 1921.	Pending	Collection of engineering data completed; all proofs filed; abstract of claims printed; period for filing notices of contest expires November 2, 1926.
Whitewater River.	Riverside and San Bernardino.	Sections 25 to 36*f*.	Dec. 9, 1922.	Pending	Hearings on all contested claims held; order of determination in course of preparation.
North Cow Creek.	Shasta	Court reference.	Apr. 25, 1923.	Pending	Tentative settlement agreed upon as a basis for distribution by Water Master during 1926 season.
Oak Run Creek.	Shasta	Court reference.	Apr. 25, 1923.	Pending	Tentative settlement agreed upon as a basis for distribution by Water Master during 1926 season.
Owl Creek	Modoc	Court reference.	Apr. 28, 1925.	Pending	Division's report as referee filed with court March 8, 1926; court decree expected in near future.
Soldier Creek	Modoc	Court reference.	May 21, 1925.	Pending	Division's report as referee filed with court March 8, 1926; court decree expected in near future.
Morrison Creek.	Del Norte	Court reference.	Mar. 5, 1926.	Pending	Collection of engineering data completed; hearing before referee held; Division's report as referee in course of preparation.
Clover Creek	Shasta	Court reference.	Aug. 7, 1926.	Pending	Preliminary field investigation made.
Butte Creek	Siskiyou	Court reference.	Sept. 30, 1926.	Pending	Work not yet commenced.

The **Burney Creek** stream system rises on Mount Burney, in the eastern part of Shasta County, and flows in a general northerly direction to its confluence with Pit River, immediately below Burney Falls. Although there is a considerable flow of water over Burney Falls at all seasons of the year, as shown in Plate 13, the entire flow supplying Burney Falls during the summer months rises in the bed of the creek immediately above the falls. During the months of June, July, August and September of each year the entire surface flow of the upper portion of Burney Creek is utilized for the irrigation of 2620 acres of land in Burney Valley. No use is made of the waters that rise immediately above the falls.

In 1916 a suit was brought in the superior court of Shasta County by Ednah M. Black, one of the water users at the lower end of Burney Valley, naming three upper users as defendants, and seeking to enjoin them from using water to her injury. Owing to the fact that the litigants were able to reach a temporary working agreement as to the use of water, the suit was not pressed until the fall of 1921, when it was referred by the court to the Division of Water Rights for investigation as referee. Upon the recommendation of the Division, eight additional water users were brought into the suit in order that the proceedings might result in a complete adjudication of all water rights on the stream system, except those on Goose Valley Creek, which tributary contributes little or no water to Burney Creek during the summer months.

A field investigation of the water supply and use of water from the stream system was made by the Division during the 1922 irrigation season, as a result of which an engineering report and a set of maps were prepared. Copies of the report and maps were submitted to the attorneys representing the various water users, and after several conferences between the attorneys and representatives of the Division the case was set for hearing in the fall of 1924, which hearing was postponed until February, 1925, at the request of several of the interested parties.

On the day set for hearing, before proceeding with the taking of testimony, the representatives of the Division went into conference with the various water users and their attorneys for the purpose of endeavoring to settle as many of the issues as possible by stipulation. After several days of such conference all parties involved agreed upon a tentative allocation of the water supply, with the provision that the same be tried out during the 1925 irrigation season under the supervision of a water master to be appointed by the Division.

Accordingly, the stream system was administered by a water master during the 1925 season upon the basis of the tentative schedule agreed upon. At the end of the season a report was prepared by the water master setting forth the results accomplished and containing several recommendations as to minor changes in the schedule that would make it more equitable.

A further conference between the Division and the water users and their attorneys was held in December, 1925, at which the various changes recommended by the water master were adopted, and all parties stipulated that the Division might submit the modified schedule to the court as its findings and that the court might enter a decree in accordance therewith. The decree was entered on January 30, 1926.

Adjudication Proceedings Pending Throughout Biennium.

Of the six adjudication proceedings that were pending on November 1, 1924, five were still pending on November 1, 1926. These proceedings cover the Stanislaus River stream system in Alpine, Calaveras, Tuolumne, Stanislaus and San Joaquin Counties, the Shasta River stream system in Siskiyou County, the Whitewater River stream system in Riverside and San Bernardino Counties, the North Cow Creek stream system in Shasta County, and the Oak Run Creek stream system in Shasta County.

In the **Stanislaus River** proceedings the final order of determination of the Division was filed in the superior court of San Joaquin County in January, 1923, and twelve notices of exception thereto were filed, some of which attacked the constitutionality of the Water Commission Act and the jurisdiction of the court. A hearing on the constitutional issues was held before Judge Plummer and the matters were submitted to him on briefs, but he was appointed to the appellate bench before rendering a decision, necessitating a rehearing. After considerable difficulty in obtaining a judge that was qualified and agreeable to all parties involved, the issues were again set for hearing before Judge Young on September 14, 1926. At the latter hearing some of the issues were disposed of by stipulation, and the remaining issues were set for hearing on December 16, 1926. The judge will rule on the constitutional and jurisdictional issues prior to November 18, 1926.

In the **Shasta River** proceedings the collection of the engineering data was completed in the fall of 1923, the engineering report and maps were filed in July, 1925, all proofs of appropriation were filed prior to January 15, 1926, an abstract of all claims has been published and copies thereof mailed to all claimants, and notice has been issued fixing November 2, 1926, as the date prior to which all notices of contest must be filed.

In the **Whitewater River** proceedings the collection of the engineering data was completed in the summer of 1923, the engineering report and maps were filed in November, 1923, all proofs of appropriation were filed prior to October 31, 1924, the abstract of claims was published and copies thereof mailed to all claimants in October, 1925, all notices of contest were filed prior to February 2, 1926, and hearings on all contested claims were held in March, 1926. The order of determination of the Division is now in the course of preparation.

The **North Cow Creek** and **Oak Run Creek** stream systems drain adjoining watersheds and work on the court reference proceedings involving these two stream systems has been conducted simultaneously. The collection of the engineering data was completed in the fall of 1923, and the engineering reports and maps were filed in April, 1925. A conference between representatives of the Division of Water Rights and all water users on both streams and their attorneys was held in February, 1926, at which a tentative allocation of the water supply of each stream was agreed upon with the understanding that such allocations be tried out during the 1926 irrigation season under the supervision of a water master to be appointed by the Division to serve on both streams. Such administration was exercised, and the reports of the water master are now in the course of preparation.

Adjudication Proceedings Initiated During Biennium.

Five adjudication proceedings have been initiated during the biennium ending November 1, 1926; all by court reference. These proceedings cover the Owl Creek and Soldier Creek stream systems in Modoc County, the Morrison Creek stream system in Del Norte County, the Clover Creek stream system in Shasta County, and the Butte Creek stream system in Siskiyou County.

The **Owl Creek** and **Soldier Creek** stream systems both have their origin on the east slope of the Warner Range of Mountains in Modoc County. The flow of Owl Creek is utilized for the irrigation of 2920 acres of land, and that of Soldier Creek for the irrigation of 1875 acres of land, both irrigated areas being situated in Surprise Valley.

In 1920 a suit was instituted by C. E. Cummins et al. in the superior court of Modoc County, involving all of the claimants to the waters of Owl Creek. During the same year another suit was brought in the same court by the San Francisco Cattle Loan Company et al. involving all of the claimants to the waters of Soldier Creek. Court hearings were held on these cases in June, 1922, and thereafter briefs were submitted by the attorneys representing the various parties. Later it became apparent that there was insufficient evidence before the court upon which to base accurate findings as to the physical facts, and on April 28, 1925, and May 21, 1925, the Owl and Soldier Creek cases, respectively, were referred to the Division of Water Rights for investigation, for the purpose of obtaining accurate data as to the water supply and water requirements of the lands involved.

The distance between Owl and Soldier creeks is only about twenty miles, and there is a good road between the two streams, which conditions made it possible for the field investigations in the two proceedings to be conducted simultaneously under the direction of one engineer. Continuous records of the water supply and diversions from the two streams were maintained throughout the 1925 irrigation season, the automatic water stage recorder installation shown in plate 14 being typical of the means by which such records were obtained.

The collection of the engineering data was completed in the fall of 1925, and the engineering reports and maps were filed in December, 1925. The reports of the Division as referee in the two cases were filed with the court on March 8, 1926, and the decrees of the court establishing the various water rights are expected in the near future.

Morrison Creek is a small tributary of Smith River, in Del Norte County. On August 6, 1924, the Division of Water Rights received an application for a permit to appropriate one cubic foot per second of the waters of the stream for use on nonriparian lands. This application was duly advertised, and being unprotested a permit was issued thereon on June 22, 1925. On September 25, 1925, two lower riparian owners brought action against the permittee in the superior court, seeking to enjoin him from proceeding under the permit. The plaintiffs claimed that they had no knowledge of the proposed appropriation prior to the issuance of permit, and that they would suffer serious injury if any of the waters of Morrison Creek were diverted out of the watershed above their lands.

On March 5, 1926, the court entered an order referring the case to the Division of Water Rights for investigation and report as referee, under the provisions of section 24 of the Water Commission Act. Pursuant to such order a field investigation of conditions on Morrison Creek was made by one of the Division's engineers on June 2, 1926, and a hearing was held by the Division in the matter on July 31, 1926. The report of the Division as referee is now being prepared and it is expected that shortly the same will be filed with the court.

Clover Creek heads in Arthur Lake in the eastern part of Shasta County, and flows in a general southwesterly direction for a distance of about twenty-five miles to its confluence with Cow Creek immediately below Millville. The stream drains the watershed adjacent to that of Oak Run Creek on the south, and a portion of its waters are diverted for use on lands situated within the Oak Run Creek watershed for which a partial water supply is also obtained from North Cow and Oak Run creeks. On account of the combined use of the waters of the three stream systems on such lands, the advisability of an adjudication of the water rights on Clover Creek developed during the course of the proceedings covering North Cow and Oak Run creeks, which latter proceedings have been previously discussed in this chapter.

On August 7, 1926, a complaint was filed in the superior court of Shasta County by the Millville Ditch Company, one of the lowest users of water from Clover Creek, naming all other users from the stream as defendants, and seeking to quiet title to its water rights. On the same day an order was entered by the court referring the case to the Division of Water Rights under the provisions of section 24 of the Water Commission Act.

A preliminary field investigation was made immediately following the order of reference, from which it was determined that on account of the low flow of the stream then existing, and the advanced stage of the irrigation season, it would be inadvisable to commence a general investigation of the water supply and use of water until the beginning of the 1927 season. Miscellaneous measurements of the stream flow and of the diversions therefrom were made during the months of August and September, however, by the water master on North Cow and Oak Run creeks.

It is roughly estimated that about one thousand acres of land are irrigated with the waters of Clover Creek.

Butte Creek rises on the northeast slope of Mt. Shasta and flows in a general northerly direction for a distance of about thirty-five miles, emptying into Butte Lake, a body of water without outlet. The natural flow of the stream during the summer months is used for the irrigation of about 2500 acres of land, and the flood waters are stored in Butte Lake, from which they are rediverted by pumping and used for irrigation within the Butte Valley Irrigation District. This district comprises a total area of about 21,000 acres, of which only about 2000 acres have been put under irrigation up to the present time.

The water rights of the Butte Valley Irrigation District are based upon permits issued by the Division of Water Rights and also upon old vested rights appurtenant to certain lands that the district purchased. In 1924 a suit was brought by the district in the superior court of Siskiyou County against various upstream water users, seeking to enjoin them from diverting water to the injury of the district. On

September 30, 1926, an order was entered by the court transferring the case to the Division of Water Rights for investigation as referee. A field investigation of the water supply and use of water from Butte Creek will be started by the Division at the beginning of the irrigation season next spring.

Cost of Adjudication by Division of Water Rights.

The cost of adjudication proceedings undertaken by the Division of Water Rights depends upon many variable factors, such as the total area of land irrigated from the stream system, the sizes of the various tracts of irrigated land, the topography of the area that must be surveyed, the number of diversions, the accessibility of the diversions, the quantity of existing hydrographic data, the number and nature of the contests that may develop, and the distance of the stream system from Sacramento.

Accurate cost data have been kept by the Division on all adjudication proceedings that have been initiated since 1918, and the results for the five of such proceedings that have been completed are shown in the following table:

TABLE 5.

Adjudication Cost Data.

Stream system adjudicated	Acreage irrigated	Amount of water decreed (continuous flow equivalent in cubic feet per second)	Cost	Cost per acre irrigated	Cost per cubic feet per second decreed
North Fork Cottonwood Creek	2,180	33.15	$763 50	$0 35	$22 75
West Fork Carson River	4,998	74.36	2,702 44	54	36 30
Hat Creek	2,447	122.35	1,624 25	67	13 25
Oak Creek	1,761	56.19	1,178 69	67	21 00
Burney Creek	2,619	32.15	1,162 80	44	36 20
Totals	14,005	318.20	$7,431 78	$0 53	$25 90

The low cost per acre in the North Fork of Cottonwood Creek proceedings is accounted for by the fact that it was not necessary to make an instrumental survey of the lands irrigated from that stream, and the low cost per cubic foot per second decreed in the Hat Creek proceedings is accounted for by the fact that an extremely low duty of water was established for the lands irrigated from that stream.

While the tabulation indicates a maximum cost of sixty-seven cents per acre of irrigated land in adjudication proceedings already completed, there are at present pending several proceedings involving relatively small total areas of irrigated land in which the cost will probably exceed one dollar per acre.

CHAPTER IV.

ADMINISTRATIVE DISTRIBUTION OF WATER.

The object of all administrative and legal activity in the matter of water rights is the ultimate distribution of the water itself to the rightful claimants. Preceding chapters have dealt with supervision over the acquisition of new rights and the adjudication of existing rights which are but means to the end that the owners of vested rights may be protected in the use to which they are entitled. On many stream systems in the state development has progressed to the stage where adequate protection to vested rights can only be afforded by state supervision over the distribution of water, through the agency of water masters. This condition was recognized by the legislature in 1921, when the Water Commission Act was amended so as to provide for the creation of "water districts" and for water master service within such districts.

Procedure Provided in Water Commission Act.

Amended sections 37 to 37*e*, inclusive, of the Water Commission Act provide for the creation of water districts by the Division of Water Rights, as necessity therefor demands, such districts to include only stream systems upon which all water rights have been adjudicated. Upon written request from the owners of at least fifteen per cent of the diversion systems entitled to water in any district, the Division may, if in its discretion necessity therefor exists, appoint one or more water masters for such district. Such water masters are authorized to distribute the waters of the stream systems among the various conduits in accordance with the determined rights, and in the performance of such duty may regulate diversion works. Changing or interfering with diversion works which have been regulated by a water master constitutes a misdemeanor punishable by fine or imprisonment, or both. Any water user who is dissatisfied with a decision of a water master, however, has the right of appeal from such decision to the superior court of the county in which the regulation takes place.

A comparison of the procedure above outlined with that contained in the codes of the thirteen other western irrigation states which have laws covering administrative distribution of the waters of their stream systems indicates that the provisions of the California act are complete and in accordance with the best practice, except that no provision for a method of financing water master service is contained in the California law. Unfortunately, the omission of provision for financing water master service makes the entire distribution procedure contained in the California act difficult if not impractical of operation.

One water district was created by the Division of Water Rights and an attempt was made to finance water master service in that district through voluntary contributions from the water users. The district embraced the watershed of the West Fork of Carson River in Alpine County, all water rights within which were determined in adjudication proceedings conducted by the Division and terminated by a court decree in 1921. The order creating the district was entered in May, 1922, upon receipt of a petition for water master service signed by the owners of twenty-seven per cent of the ditches entitled to water from the stream. The suggestion of the Division that distribution within the district be financed by voluntary contribution met with ready response from the lower users, but was accepted with reluctance by most of the upper users. Nevertheless, in spite of some unwillingness on the part of various upstream users to bear their portion of the expense, it was possible for the Division to provide water master service in the West Carson District during the 1922 and 1923 irrigation seasons, principally due to the fact that a group of the lower users practically guaranteed the necessary funds to cover the cost of the work. In the latter part of the 1923 season, however, the river dropped to a very low stage and some of the upper users became dissatisfied with the amounts of water delivered to them. As a consequence, attempts to finance water master service in the district through voluntary contributions in the 1924, 1925 and 1926 seasons failed because of lack of cooperation from various upper users, who, because of their strategic position on the stream, are apathetic regarding supervision of diversions.

Because of the failure in the instance of the West Carson District, no further attempts have been made by the Division of Water Rights to administer the distribution of water under the provisions contained in the Water Commission Act. At the present time, however, there are several areas in the state within which the water rights have been adjudicated, and within which water master service is desired by a majority of the water users. These areas should properly be embraced in water districts at such time as the act may be amended so as to provide a method of financing water distribution.

Appreciating that no material progress can be made in administering the distribution of water in California until the above mentioned deficiency in the Water Commission Act is supplied, the Division has given very careful consideration to the matter of an equitable and practical method of apportioning and collecting the necessary funds for water master service. As a result of this investigation it is concluded that the most satisfactory method in operation in any irrigation state is that provided in the law enacted by the Nevada legislature in 1921, and under which water master service has been successfully financed in that state for the past five years.

Under the Nevada law each water master is paid by the county in which his water district is situated, from a special water district fund. If the water district embraces more than one county, the expense is apportioned among the counties in the ratios that the water rights within each county bear to the aggregate water rights in the district. Prior to the first Monday of April of each year the State Engineer submits to the board of commissioners of each county a budget showing the estimated cost of water master service for the ensuing fiscal year for all water districts within the county, together with a statement showing the ratios that the water rights of each user bear to the aggregate of the water rights within his district, and the charge against each user based upon such ratios. Upon the receipt of such budgets and statements, the county commissioners are required to certify the respective charges against the water users to the county assessor, and it is made the duty of that official to enter the charges against the respective water users and their land served, on the county assessment roll. The charges become liens upon the properties served, and are collected by the county tax collector in the same manner that other taxes are collected. The sums thus received from the various water users within a district are deposited in the water district fund of that district. All bills for water master service must be certified by the State Engineer and approved by the board of county commissioners, after which the county auditor is authorized to draw warrants therefor from the proper water district fund.

Distribution Authorized by Court Decrees.

On account of the impracticability of administering stream systems under the provisions of the Water Commission Act in its present form, the Division of Water Rights has recommended to the court, in all adjudications that have been accomplished through court reference covering stream systems on which there appeared necessity for water master service, that provision for such service be contained in the decree establishing the water rights. In accordance with such recommendations the decrees in the North Fork of Cottonwood Creek, Hat Creek, and Burney Creek adjudication proceedings contain provisions to the effect that upon petition of any water user the Division may, if in its discretion necessity therefor exists, appoint a water master to supervise the distribution of the waters of the stream system in accordance with the terms of the decree, during the then current irrigation season. It is further provided in those decrees that all expense of such water master service shall be borne by the parties in the respective ratios that their water rights bear to the aggregate of all water rights on the stream.

Water master service was successfully provided under provisions of court decree on the North Fork of Cottonwood Creek during the 1924 season, on Hat Creek during the 1924, 1925 and 1926 seasons, and on Burney Creek during the 1926 season. No petition for water master service on the North Fork of Cottonwood Creek was received during either the 1925 season or the 1926 season, and it is thought that the regulation on that stream in 1924, and the structures that were installed on the ditches during that season, have so systematized diversions that necessity for water master service on the stream in future years has been eliminated.

Distribution Authorized by Agreements.

On some stream systems in the state the need for supervision over diversions has become so acute that the water users have voluntarily entered into agreements providing for water master service. Such agreements specify the authority and duties of the water master, and the basis upon which the distribution is to be made, and provide for the apportionment of the expense of water master service among the water users served.

In the case of a stream on which the water rights have not been adjudicated and can not be definitely agreed upon, the authority of the water master may be limited to general supervision over diversions for the purpose of eliminating all wasteful use of water. Such agreements were signed on the Sacramento River in 1920 and 1924. On the other hand, in the case of a stream on which the water rights have been established by court decree, the water master may be given absolute authority to regulate headgates so as to effect distribution in accordance with the definite amounts and priorities of the various rights. Such an agreement was signed on Cedar Creek, Modoc County, in 1926.

Water master service under authority of agreements entered into by the water users has been provided on Kings River each season commencing with 1919, on the Sacramento River during the 1920, 1924, 1925 and 1926 seasons, on Shasta River during the 1924 and 1926 seasons, on Burney Creek during the 1925 season, on Owl Creek during the 1925 and 1926 seasons, on Soldier Creek during the 1925 and 1926 seasons, on Cedar Creek during the 1926 season, on North Cow Creek during the 1926 season, and on Oak Run Creek during the 1926 season.

Stream Systems Administered During Biennium.

State supervision over the distribution of the waters of ten stream systems in the state was exercised during the biennium ending November 1, 1926.

Water master service under the **Kings River** agreement, which service was commenced in 1919 and has been described in previous biennial reports, was continued throughout the past biennium. The distribution of the waters of Kings River, and the related work undertaken by the Division of Water Rights, are subjects of sufficient importance to justify a separate chapter and are accordingly covered in Chapter VI of this report.

General supervision over diversions from the **Sacramento River,** similar to that rendered under the agreements of 1920 and 1924, and described in Appendix "J" of the 1920 Biennial Report of the State Water Commission, and in Chapter XI of the 1924 Biennial Report of the Division of Water Rights, respectively, was continued during the 1925 and 1926 seasons. The supervision was exercised during the past biennium in conjunction with a general study of the water problems of the Sacramento and San Joaquin rivers, for which type of investigation special funds were appropriated at the 1925 session of the legislature.

Chapter IX of this report is devoted to the Sacramento and San Joaquin rivers investigation and includes a discussion of the supervision exercised over diversions.

The general supervision over diversions from **Shasta River,** which was commenced in 1921, was continued during the 1925 and 1926 seasons. The events which lead up to such supervision, and the results accomplished during the 1921, 1922, 1923 and 1924 seasons, have been described in detail in Chapter V of the 1924 Biennial Report of the Division of Water Rights.

The water supply of Shasta River and its tributaries held up fairly well during the 1925 irrigation season. There was at times insufficient water to supply all users and several complaints of interference were received. On account of its familiarity with the local conditions through past experience the Division was able to suggest methods of cooperation among the water users which resulted in disposing of all the complaints except in one case in which the shortage was so severe that it was necessary for a representative of the Division to spend four days in Shasta Valley and put into effect a plan of operation whereby the shortage was taken by the latest appropriators on the stream.

The season of 1926, however, was one of very low water supply and complaints of interference were received from several of the lower users as early as April 3d. Through the voluntary efforts of the water users and the assistance of an engineer of the Division who was in the valley a short time on other matters it was possible to take care of the situation until early in June when the water supply became utterly inadequate and the whole matter critical so far as the lower users, who have some of the oldest rights, were concerned.

It appeared that litigation would result if immediate relief was not afforded. A meeting of the Shasta Valley Water Users Committee was held at Montague on June 17th, at which time the Division was asked to appoint a water master to take charge of the river until at least the end of August and funds to carry on such work were provided.

Mr. Harrison Smitherum was appointed water master by the Division and had charge of the diversions until August 31st. General administration as described in the 1924 Biennial Report of the Division of Water Rights was exercised except that the Little Shasta Valley area was eliminated from the supervision due to the extremely low flow of Little Shasta River which was impractical of regulation.

The water master service on **Hat Creek** which was commenced in 1924 under the provisions of the decree entered in the court reference proceedings which resulted in the determination of the water rights on that stream, was continued during the 1925 and 1926 irrigation seasons, upon receipt of petitions from water users received at the beginning of each of those seasons. The details of this adjudication proceeding, and of the subsequent water master service in 1924, have been described in Chapters IV and V, respectively, of the 1924 Biennial Report of the Division of Water Rights.

The continuation of the service during the past biennium has been marked by increased care on the part of the water users in handling their water, and in many instances by improvements in the ditch systems and in the preparation of the lands to receive water. As a result gradually increasing crop yields are being obtained on many of the ranches.

At the beginning of the water master service in 1924, the work of the water master in regulating diversions was greatly hampered because of the lack of suitable control works and measuring devices on the ditches. Such structures have since been installed on all of the ditches and a material saving of the water master's time has thus been effected. Whereas the regulation of diversions on Hat Creek required the water master's full time during the 1924 season, one man has been able to handle the regulation on both Hat and Burney creeks during the 1925 and 1926 seasons, thus effecting a material saving in expense to the water users of both streams.

Burney Creek was administered by water master during the 1925 and 1926 seasons. In February, 1925, all claimants involved in the adjudication proceedings covering the water rights on that stream reached an agreement providing a tentative schedule for water distribution, with the provision that such schedule be tried out during the 1925 season under the supervision of a water master to be appointed by the Division of Water Rights. The events that lead up to such agreement have been described in the discussion of the Burney Creek adjudication proceedings contained in Chapter III.

The waters of the stream were distributed in accordance with the agreement during the 1925 season by the same water master who served on Hat Creek, and no serious difficulties were encountered. As a result all water users on the stream agreed to a final settlement of their rights based upon the tentative schedule with several minor changes, and in January, 1926, a court decree was entered thus establishing the rights. The decree provides that upon petition of one or more water users the Division of Water Rights may, if in its discretion necessity therefor exists, appoint a water master to supervise the distribution of water from Burney Creek during the then current irrigation season.

In April, 1926, the Division received a petition signed by four of the twelve water users on Burney Creek, requesting the appointment of a water master for the 1926 season. The service was rendered in conjunction with similar service on Hat Creek, as in 1925. An extreme shortage of water occurred on Burney Creek during the latter part of the 1926 season, but injury to crops was kept to a minimum through the one hundred per cent cooperation that the water master received from the users. All of the ranchers voluntarily limited their irrigation to such areas as could be supplied with the quantities of water available, and no serious conflicts arose. General sentiment in Burney Valley is strongly in favor of the continuation of rotation in the use of irrigation water under the supervision of a water master, and in marked contrast to conditions on various other streams where supervision over diversions has been exercised, the need for water master service is recognized by the upper users on Burney Creek as well as by the lower users.

Diversions from **Owl Creek** and **Soldier Creek** were regulated by the Division of Water Rights during the 1925 and 1926 seasons. At the beginning of the field investigation in the adjudication proceedings covering those two streams, as described in Chapter III, all water users on each stream agreed that diversions might be regulated during the 1925 season by the engineer in charge of the investigation, in order to facilitate a study of the water requirements of the various lands.

In making such regulations, all rights were to be treated as of equal priority, and when the water supply became inadequate for all irrigated lands it was to be prorated among the users in proportion to their irrigated areas. The water users on Soldier Creek further agreed to a rotation schedule conforming to what had been the voluntary practice on that stream for several years prior to 1925.

All diversions from the two streams were regulated during the 1925 season in accordance with the agreements, and careful observation was made of the results of the use of water on each ranch. The water requirements of the various users were thus determined, and in March, 1926, the Division submitted reports to the court setting forth its findings thereon.

Immediately following the filing with the court of the reports of the Division as referee, all water users on both Owl and Soldier creeks signed agreements providing for distribution by water master during the 1926 season based upon the Division's findings, and for the payment of the necessary funds to cover the expense of such service. Accordingly, a water master was appointed for the two streams, who assumed his duties in the field on April 1st and served until July 3d, by which time the water supply of both streams had dropped to such a low stage that no water was available for irrigation and consequently no further regulation was necessary.

AUTOMATIC WATER STAGE RECORDER INSTALLATION.

By means of this recorder a continuous record of the flow in Soldier Creek, Modoc County, is obtained and an equitable distribution of the flow among the claimants made possible.

PLATE 14.

The court decrees that will establish the priorities of the various rights on Owl and Soldier creeks have not as yet been entered, consequently it was necessary for the water master to treat all rights as of equal priority during the 1926 season. Unfortunately the run-off of both streams was extremely low during 1926, being inadequate to supply full allotments at any time during the season. The water supplies were apportioned among the various users in proportion to their allotments, and this led to some dissatisfaction on the part of several of the parties who claim very early priorities. Most of the water users appreciated the inadequacy of the water supplies and the lack of a basis for distribution in accordance with priorities, however, and no serious objections to the 1926 distribution were made. It is anticipated that the priorities will be established before 1927, and that future distribution will be made on a priority basis.

Diversions from **Cedar Creek** were regulated during the 1926 season by the same water master who served on Owl and Soldier creeks. This stream heads near Cedar Pass on the east slope of the Warner Range of mountains, and flows in a general easterly direction into Middle Lake, in Surprise Valley, Modoc County. Foreign water is conveyed to Cedar Creek from Toms Creek, a stream draining the west slope of the Warner Range, by means of what is known as the "Toms Creek Ditch," such foreign water being discharged into Cedar Creek near its head.

All rights to Cedar Creek water were established by the superior court decree entered February 15, 1923, in the case of *Hill et al.* v. *Acty et al.*, and all rights to the foreign water conveyed from Toms Creek were established by the superior court decree entered May 22, 1901, in the case of *Lighty* v. *Cook et al.*

In March, 1926, all water users on Cedar Creek signed an agreement providing for supervision over diversions from that stream during the 1926 season upon the basis of the above mentioned decrees. The service was rendered as above stated, and in spite of the fact that the 1926 run-off of Cedar Creek was extremely low and inadequate to supply the full allotments decreed at any time during the season, the water users appeared well satisfied with the results accomplished. The success of the service is evidenced by the fact that at the conclusion of the 1926 season all water users on Cedar Creek signed an agreement providing for similar service in 1927.

Diversions from **North Cow Creek** and **Oak Run Creek** were regulated by water master during the 1926 season in accordance with agreements entered into by all parties involved in the adjudication proceedings covering those streams, which proceedings have been described in Chapter III. The distribution was made in accordance with the tentative schedules agreed upon, but the 1926 run-off was too low to demonstrate whether or not the schedules will prove satisfactory under normal conditions. Some modifications of the schedules appear desirable in view of the 1926 regulation, and it is hoped that modified schedules can be tried out under normal conditions, and that such further trial will afford the basis for final settlement by agreement of all of the water rights involved.

CHAPTER V.

WORK OF LEGAL DEPARTMENT.

By SPENCER BURROUGHS, Attorney for Division.

To those familiar with the water problem in California and its especially complicated condition due to the recognition in this state of both the appropriative doctrine and the riparian doctrine, it will be readily apparent that the Division of Water Rights in passing upon applications for permits to appropriate water is called upon to perform functions at once legal and quasi judicial in character as well as engineering. Whatever may be the strictly legal definition of the power exercised by the Division, whether it be quasi judicial or merely ministerial, the fact is nevertheless undeniable that the Division is faced with the necessity of passing upon the extent of existing rights to water and that this duty is particularly emphatic in instances of protested or contested applications. This problem of passing generally and for its own purposes upon the rights of others and of protestants is oftentimes one of intricate legal as well as difficult engineering consideration.

While no attempt is made to adjudicate the rights of protestants or others as among themselves it is nevertheless necessary for the Division to estimate the total quantities of water derived from the source involved which are included within prior vested rights, to the end that said total may be compared with the total amount of water found to exist in said source of supply. A deduction is then made as to what quantity, if any, is unappropriated and available to the applicant. The Water Commission Act in section 1*d* very definitely prescribes that unappropriated water is a prerequisite to issuance of a permit and the application itself is expressly declared by the act to be for unappropriated water and is of course issued subject to vested and existing rights and takes a priority subsequent in right thereto. Hence difficult legal problems often confront the Division in its decisions relative to action upon applications and after such questions have been briefed by opposing counsel, the Division must necessarily, and as preliminary to issuance of a permit, or rejection of an application make a decision thereon.

A little different in kind are questions of a legal nature which frequently arise relative to the interpretation and application of specific portions of the Water Commission Act. Although this statute has been in force since December 19, 1914, and retains considerable portions which have been unchanged by amendment, there have been but very few decisions of the courts of this state thus far rendered which assist in the interpretation of the act.

Also, relative to the court reference procedure provided for in section 24 and the adjudication procedure set forth in sections 25 to 36*f* inclusive, the duties of the Division are in their nature judicial as well as engineering and hence entail a considerable amount of legal advice.

It thus appears that whether the Division is functioning relative to the initiation of new rights by appropriation or whether it is performing duties in connection with determinations of rights to water the work is one of law and of fact and although the chief value of the work is the ascertainment of facts by engineering investigation and study yet the application of the law must be made prior to final action and oftentimes as the work progresses. Although not a court and although not vested with the determinative power of a court the Division is obliged to apply the law to the facts as it finds them and a correct application of the law in the first instance is, of course, an accomplishment highly desirable and important.

Also, there are many questions of policy and procedure constantly arising in the course of daily routine which are submitted to the attorney for advice as well as correspondence involving legal considerations, and the result of the whole situation is that the attorney's time is fully occupied in giving oral advice, writing opinions for office use, assisting as called upon in the work of deciding the proper action upon applications to appropriate, giving counsel as to the conduct of court reference and appropriative water right determinations and conducting litigation to which the Division is a party by virtue of the filing of its order of determination in stream system adjudication proceedings or is made a party by aggrieved applicants or protestants.

A general résumé of the work performed by the legal department has been given in the preceding several paragraphs. The following paragraphs contain a brief statement of the cases in which the Division is or has been a party.

Tulare Water Company v. State Water Commission, 187 Cal. 533.

The nature of this action has been discussed in the fifth biennial report of the Division, pages 62 and 63, and inasmuch as a trial of this proceeding is still pending under stipulation as therein explained it can only be stated that in considering the present applicability of this decision it should be noted that the Water Commission Act has been amended by the addition of new sections 1*a*, 1*b*, 1*c* and 1*d* in 1923 and also by amendment of section 16 in 1925 and the addition thereto of provisions relative to giving notice of an application and relative to protests against an application and relative to notice of hearings on protested applications. The constitutionality of section 1*b* is now before the Supreme Court in a case hereinafter referred to, *California Delta Farms, Inc., et al.*, v. *East Bay Municipal Utility District et al.*; this is also before the second District Court of Appeal in the case of *Mojave River Irrigation District* v. *Superior Court, infra.* The Third District Court of Appeal has held that section 1*b* is not applicable prior to the time a hearing has been held upon an application to appropriate, *Rich* v. *McClure.*

Rich v. McClure, 50 Cal. App. Dec. 311.

A statement of this case is contained in the fifth biennial report of the Division, pages 63 and 64; therefore, the present discussion will be limited to the history of this case since the rendition of said report.

The judgment of the superior court was that defendants should proceed to hear and act upon petitioner's application; the Division appealed to the Third District Court of Appeal, which court affirmed the judgment of the trial court and denied a rehearing. The Supreme Court denied a hearing, Justices Shenk and Curtis dissenting.

This decision of the appellate court holds that section 1*b* is inapplicable as a remedy prior to the holding of a hearing before the Division and that, "It is to be presumed that the provisions of section 16 of the act, requiring an application to set forth 'the location and description of the proposed headworks, ditch, canal and other works,' relate to the work which the applicant proposes to construct, not to works to be constructed and used by purchasers of the water and over which the applicant will have no control."

This decision, however, is gratifying to the Division of Water Rights in that it upholds a very important contention urged by the Division and denied by the petitioner, to wit, that place of sale is not place of beneficial use and in the opinion it is declared, "For obvious reasons, the places of intended use must be stated, whether that use is to be made by the applicant or by those to whom he may sell the water."

A doctrine of sale as beneficial use would open the door wide to speculation, would enable anyone to proceed with an application and hold up bona fide projects, and would make it difficult, if not impossible, for the Division to trace the development made, if any, and ascertain whether a really bona fide seller of water was in fact selling that water to parties who were making an actual beneficial use of all the water sold. Sale in itself as a use would make it possible for A and B to conspire, A to sell water to B at nominal price, and B to waste the same until the necessity of some later bona fide appropriator would enable A and B to extort their price. Thus a real development might be made the prey of a speculator, and the Division was prompted in its fight against this doctrine of sale as use upon the theory that it would thwart legitimate development and seriously retard the bona fide use of water in California. A doctrine which would lend itself to speculation in an element vital to the growth and prosperity of the state should not be countenanced and in this decision the appellate court has very evidently held that sale is not in itself a beneficial use of water.

Department of Public Works v. Superior Court (two proceedings, 70 Cal. Dec. 446 and 70 Cal. Dec 452.)

The story of this litigation is somewhat complicated. The real parties interested were the Klamath River Packers Association and the State Fish and Game Commission. These parties instituted separate suits in the Superior Court of Siskiyou County, (*Newbert et al* v. *Department, etc.: Klamath River Packers Association* v. *Department, etc.*) and petitioned for writs of certiorari to review and annul a certificate issued by the Division of Water Rights under section 12 of the Water Commission Act. The certificate complained of was one fixing time for complete application to beneficial use of water under a claim of right by appropriation initiated prior to passage of the Water Commission Act. The certificate was issued to the Electro Metals Company which proposed to construct a high dam on the Klamath River and develop power.

Mistaken in their theeory as to the effect of such a certificate and apparently believing that the issuance of same confirmed and adjudicated a right in favor of said company the Packers Association sought to annul the certificate fearing that the high dam contemplated would prove an impassable barrier to salmon ascending to their spawning grounds with the consequent destruction of the salmon run in the Klamath River. Fearing also the incompetency of the fish to negotiate the dam proposed, the Fish and Game Commission likewise sued to annul the certificate via a proceeding in certiorari. The Commission maintains a fish hatchery and egg-taking station above the dam site and the packers' association operates a cannery at the mouth of the river.

The Division moved to quash alternative writs of certiorari issued by the superior court and being unsuccessful then instituted prohibition proceedings in the Third District Court of Appeal and after decisions in said court making the writs peremptory (43 Cal. App. Dec. 828 and 43 Cal. App. Dec. 836) the Supreme Court granted hearings and denied writs of prohibition (69 Cal. Dec. 331 and 69 Cal. Dec. 336) whereupon the Division of Water Rights was successful in obtaining rehearings and also a final decision that writs of prohibition should issue. (70 Cal. Dec. 446 and 70 Cal. Dec 452.)

The importance of this litigation consists in fixing the status of the duties performed by the Division under a portion of section 12 of the Water Commission Act which provides that in the case of rights initiated prior to the Water Commission Act the Division may fix a time for complete application to beneficial use if same has not yet been consummated and if in the judgment of the Division the right claimed has been diligently maintained. In issuing such a certificate the Supreme Court held that the Division does not exercise judicial power and that its action in issuing a certificate is not reviewable by certiorari. The court also very properly distinguished this provision of the act from other provisions providing for court reviews and in particular declared the inapplicability of section 1*b* to a section 12 application. The decision is also important as a recognition by the Supreme Court of the distinct and separable portions of the act relating to initiation of rights on the one hand and to determination of rights on the other hand.

Other Klamath River Suits.

As to the dispute as to the usage of the waters of the Klamath River as between the proponents of high dams for power development and the proponents of fish conservation, the latter have apparently blocked power development by the passage of an initiative measure creating the Klamath River Fish and Game District.

However, prior to the institution of the movement to secure the initiative measure above referred to, the Division of Water Rights, as it was clearly impelled by law to do, issued permits upon applications to appropriate Klamath River waters for power development and there are now pending four suits in the superior court of Humboldt County and two in the superior court of Siskiyou County which are directed against the Division and which seek to have the permits issued reviewed and annulled. These suits are at present dormant and no opinion is attempted as to the outcome in the event that the power permittees attempt to proceed. In that event the validity of the initiative measure will probably be assailed by the permittees as well as the application of it to permits issued prior to its adoption.

Beyer et al. v. Department of Public Works, etc., et al.

In this proceeding the Superior Court of San Diego County overruled demurrers interposed by defendants and proceeded to trial upon the basis that the pleadings filed by plaintiffs were sufficient to constitute an action under section 1*b* of the Water Commission Act. The permit assailed in this proceeding was issued to the Coronado Water Company to divert from the underground flow of the Tia Juana River Basin and the parties plaintiff claimed their alleged riparian rights were infringed. Many of the parties plaintiff withdrew prior to trial. However, the superior court of San Diego County has rendered judgment annulling the permit issued upon the ground that the Division had no jurisdiction to issue a permit, the source of supply being held to constitute an underground basin and not underground waters flowing through known and definite channels. Section 42 of the Water Commission Act limits the jurisdiction of the Division to surface water and to subterranean streams flowing through known and definite channels. It is not known at this date whether any of defendants will appeal from this judgment or whether defendants will rest content with the definition placed upon the water applied for.

Coronado Water Co. v. Department of Public Works, etc., et al.

This proceeding involves a permit granted to take from the same source as in the *Beyers* case above. The case has not yet proceeded to trial but the same judgment as in the *Beyers* case is to be expected. It is oftentimes very difficult to draw the line between the waters of an underground basin and of a subterranean stream flowing through known and definite channels. The case of *Los Angeles* v. *Pomeroy*, 124 Cal. 597, 633 is of interest in this connection. In that case a definition of "defined" and "known" as applied to channels was given and the waters in question held to constitute an underground stream flowing through "known" and "defined" channels.

Wennhold v. Kluegel et al.
Heimsoth v. Kluegel et al.

A full statement of the nature of these proceedings having been previously given in the Division's fifth biennial report, pages 69 and 70, it but remains to state that the plaintiffs have moved to strike out most of defendants' answers and have also demurred thereto and a hearing upon these motions and demurrers is now imminent.

California Delta Farms, Inc., et al. v. East Bay Municipal Utility District, et al.
Preston v. Department of Public Works, etc., et al.

These actions were instituted to review the permit issued by the Division of Water Rights to the East Bay Municipal Utility District to appropriate water from the Mokelumne River for municipal purposes. The district comprises the cities of Oakland, Berkeley, Alameda and neighboring municipalities. Under the interpretation placed upon that portion of Section 20 of the Water Commission Act relative to applications by municipalities the Division issued a permit to the district upon the theory that its application, although filed subsequent in time to other pending applications, was entitled to a priority of right. The Division also ruled that the preference accorded under Section 20 included use for general municipal purposes as well as for the private domestic use of inhabitants of the district. Protestants at the hearing included J. W. Preston, a prior applicant in point of time and also the California Delta Farms, Inc., and others. Certain of the protestants filed the actions above referred to under authority of Section 1*b* of the Water Commission Act and thereupon the East Bay district demurred upon the ground that the said section was unconstitutional. The Division, although a defendant, joined with the plaintiffs in arguing for the constitutionality of the section assailed. The judgment of the superior court of Amador County was that the section was unconstitutional and the demurrers of the district were therefore sustained without leave to amend. The plaintiffs have appealed from this judgment to the Supreme Court and the transcript is now on file in the appeal taken by California Delta Farms Inc., et al.

Dix Van Dyke et al. v. Department of Public Works et al.

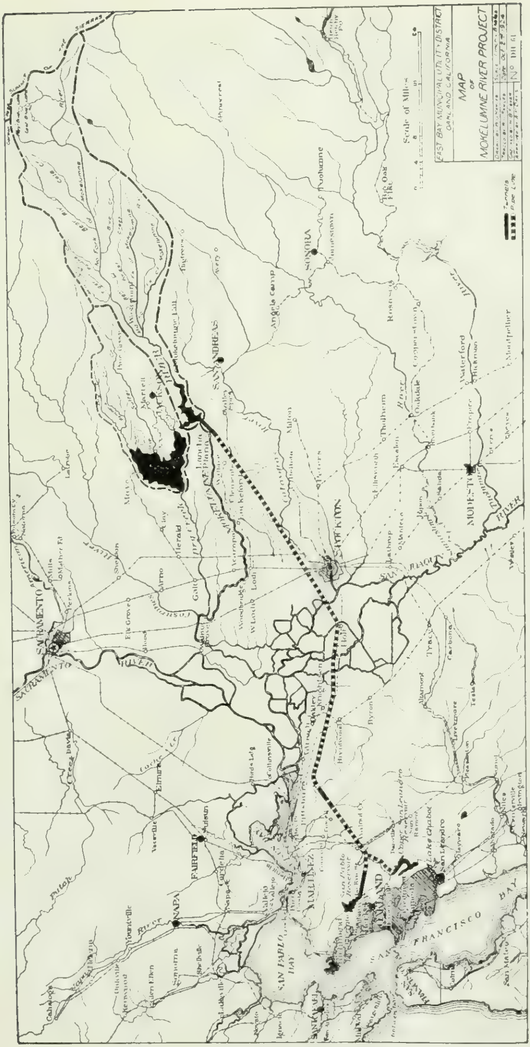
This suit was instituted by many parties protestant against the issuance of a permit to the Mojave River Irrigation District and is a proceeding under section 1*b* of the act. Demurrers of the district and the Division have been overruled and the date of trial is set for December 1, 1926; however, an alternative writ of prohibition has been secured by the Mojave District in the matter of the next entitled action.

Mojave River Irrigation District v. Superior Court.

As above stated this suit for writ of prohibition has been instituted by the petitioner district which seeks to enjoin the superior court of San Bernardino from proceeding to trial in the *Dix Van Dyke* case, *supra*. An alternative writ of prohibition has been issued by the Second District Court of Appeal, and the date for hearing of the alternative writ is set for November 23, 1926. The petitioner in its points and authorities in support of its petition for the writ attacks the constitutionality of section 1*b* of the Water Commission Act upon the ground that said section is a special law regulating the practice of courts of justice and also upon the ground that it constitutes an appeal from an executive department to a judicial department of government. The Division has suggested that all parties stipulate to a continuance of this case and the *Van Dyke* case pending decision by the Supreme Court in the case of *California Delta Farms, Inc., et al.* v. *East Bay Municipal Utility District et al., supra*, and that the parties to this case appear as *amici curia* in the latter case.

Yuba River Power Company v. Department of Public Works, etc., et al.

This is a suit instituted under section 1*b* of the Water Commission Act by the Yuba River Power Company and constitutes another chapter in the struggle which has been in progress for several years between the Yuba River Power Company and the Nevada Irrigation District and its predecessors in interest. Many applications, some conflicting, are on file by the power company and the district and recently the Division of Water Rights approved certain of the applications of the district. The power company considers that said approvals are injurious to priorities claimed by it under certain of its own applications which have not yet been acted upon. The company claims that certain of its applications are prior in time and therefore prior in right and that the provisions of section 2*a* of the California Irrigation District Act are unconstitutional. The section referred to authorizes the State



MAP OF THE MOKELUMNE RIVER PROJECT OF THE EAST BAY MUNICIPAL UTILITY DISTRICT

PLATE 15.

Engineer to request a withdrawal of waters from appropriation pending an investigation of a proposed irrigation district project and authorizes the Division of Water Rights to make such a withdrawal. Acting under authority of this section a withdrawal was made of certain waters of the Yuba River and during the period of said withdrawal the Yuba Power Company filed applications to appropriate said waters whereas the withdrawal was made in favor of the investigation of the proposed Nevada Irrigation District. Parties acting on behalf of the proposed district then filed applications for said waters and also during this withdrawal and in approving said applications the Division of Water Rights held that they were prior in right by virtue of said withdrawal although not prior in time to the conflicting applications filed by the company during this withdrawal period.

A demurrer of the Yuba River Power Company was recently heard based upon the ground of the unconstitutionality of section 2*a*; however, the judgment of the superior court of Nevada County was in favor of the constitutionality of said section and the trial of this case is set for December 7, 1926.

It is interesting to note that the Nevada District did not attack section 1*b* as unconstitutional although aware of the proceedings held in the Amador case above referred to.

Department of Public Works, etc., v. Sullivan.

This was a justices' court case brought in Burney Township, Shasta County, to collect a small amount due from L. H. Sullivan for water master service furnished by the Division of Water Rights in distributing water under a decree of the superior court in the Hat Creek Reference, case of *Doyel et al.* v. *Massie et al.* The Division was actively represented in this case by Judge Tillotson of Redding and the defendant appeared *in propria persona.* Judgment was given in favor of the plaintiff and defendants' appeal was dismissed by the Supreme Court.

Recently it became necessary to again sue Mr. Sullivan for the same kind of service rendered and the justices' court has again rendered judgment in favor of the Division.

In re Stanislaus River.

This proceeding was instituted as an adjudication of appropriative water rights under the provisions of sections 25 to 36*f* of the Water Commission Act and has now reached the point where it has become a proceeding in the superior court of San Joaquin County. To the order of determination filed by the Division of Water Rights there were twelve exceptions filed. Although the major conflict involved has been adjusted there remain several exceptors who are to be heard by the court on December 16, 1926, provided the constitutionality of this adjudication procedure is meanwhile upheld. The Division of Water Rights and the Sierra and San Francisco Power Company have filed briefs in support of the Water Commission Act whereas certain other exceptors have attacked the act as unconstitutional.

In re Whitewater River.

In re Shasta River.

In addition to the actions and proceedings heretofore mentioned, the Division will probably be called upon to support in court, orders of determination which will ultimately be filed by it in the matter of two water right adjudication proceedings now in progress under the provisions of sections 25 to 36*f* of the Water Commission Act These proceedings are relative to rights by appropriation in and to the waters of the Whitewater River in Riverside County and the Shasta River in Siskiyou County.

Black v. Grinnell et al. (Burney Creek, Shasta County.)
Lemm et al. v. Rutherford et al. (North Cow Creek, Shasta County.)
Colby et al. v. Strayer et al. (Oak Run Creek, Shasta County.)
Morrison et al. v. Hight. (Morrison Creek, Del Norte County.)
Cummins et al. v. Allen et al. (Owl Creek, Modoc County.)
San Francisco Cattle Loan Co. et al. v. Crampton et al. (Soldier Creek, Modoc County.)

The above named suits have been brought in the Superior Court for the adjudication of water rights and have been referred to the Division as referee under section 24 of the Water Commission Act. They are suits in connection with which the Division has performed work during the past biennium and relative to the two last named referee reports have been submitted.

Millville Ditch Company v. Hufford et al. (Clover Creek, Shasta County.)
Butte Valley Irrigation District v. Bray et al. (Butte Creek, Siskiyou County.)

These two suits have very recently been referred to the Division as referee and field investigations will be undertaken with the beginning of the irrigation season next year.

Herminghaus et al. v. Southern California Edison Company.

The Division of Water Rights in conjunction with Attorney General U. S. Webb has entered an appearance in this case as *amicus curiæ* because of the importance of this decision in the event that the Supreme Court finds it necessary to pass upon certain points involved. A brief has been filed by General Webb and the attorney for the Division setting forth the aspects of this case from the standpoint of the public welfare and strictly legal considerations in support have been treated of in a brief filed by attorneys representing many irrigation districts.

The decision in this case will be of great general interest and consequence in the event that the court decides whether a riparian owner may store water within the scope of his riparian right or whether a riparian owner on the lower reaches of a stream may demand that the winter floods be not interfered with but shall be allowed to overflow his lands and naturally irrigate them and deposit silt.

It is the contention of the state as *amicus curiæ* and of the irrigation districts that riparian ownership does not include the right to storage of the winter flow for summer use, but that such storage may only be accomplished through the initiation of an appropriative right as provided in the Water Commission Act, and further that riparian ownership does not include the right to natural irrigation by overflow but that the riparian owner is only entitled to an amount of water reasonably necessary by the ordinary and usual methods of diversion and use.

CHAPTER VI.

PROGRESS ON KINGS RIVER.

Kings River rising in the Sierra Nevada Mountains east of Fresno and flowing southwestward through Fresno and Kings Counties into Tulare Lake on the south and northerly through Fresno Slough into San Joaquin River on the north is the most important source of water supply for irrigation in the state at the present time. Its mean annual flow is 1,900,000 acre-feet of which 1,400,000 acre-feet are normally diverted by 45 canal systems to irrigate some 700 000 acres of land. It has made possible the great development and wealth of these two counties, and holds out promise of future wealth by the conservation through storage of the remaining 500,000 acre-feet, and the additional use of its waters for the production of hydro-electric energy in its upper reaches.

The State Water Commission and Division of Water Rights have been closely identified with the effort to more fully utilize the water of Kings River since 1917, when the Commission at the request of the Kings River Conservation District Association, undertook an investigation on Kings River which was primarily intended to furnish data with which to determine water requirements, existing rights, etc., preparatory to the construction and operation of a large storage reservoir at Pine Flat. Measurement in a systematic and comprehensive manner of all canal diversions from Kings River was at once undertaken and a record thereof has since been continuously maintained.

In 1921 general litigation on the river became imminent and to avoid this catastrophe the Division was asked to prepare a schedule for the diversion and administration of the waters of the river for the year 1922, the agreement between the users requesting the assistance of the Division being signed by interests representing more than 95 per cent of the appropriations. Such a schedule was prepared by the Division and operated for the 1922 season under the direction of Mr. C. L. Kaupke, water master, who had since 1917 been in charge of the investigational work. The results of this experiment being satisfactory the same method was agreed to for another year, and the schedule has been operated each season from 1922 to date practically without change from its original form and allotments.

Since the first two years of the investigation the cost of which was carried by the state, the cost of the work has been met almost entirely by the local interests, the Division's financial assistance being very small. Such cost has averaged about $12 000 per year or about 1½ cents per acre for the 800,000 acres benefited.

The scope of the water master's work has been extended from year to year until at the beginning of the current biennial period it embraced the following:

1. Administration of diversion schedule by water master.
2. Ascertainment of daily diversions by all canals taking from the river.
3. Measurement of the division between North Fork and South Fork of Lower Kings River.
4. Ascertainment of flow into Tulare Lake and through Fresno Slough from Kings River.

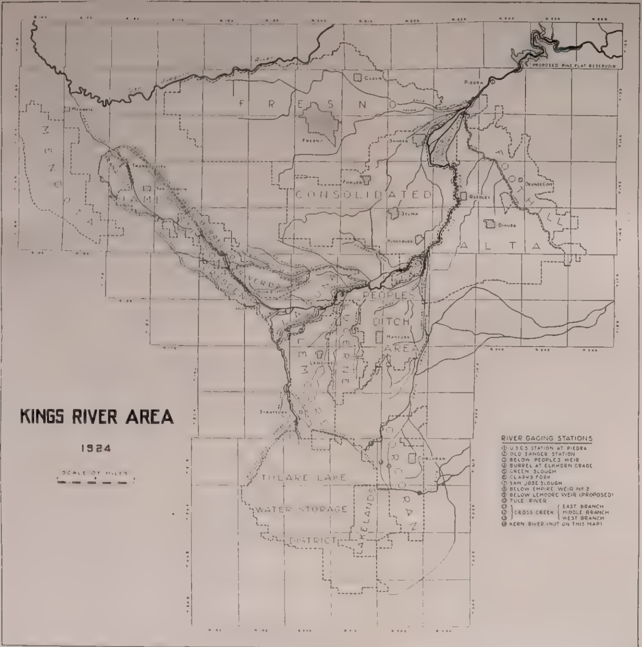

KINGS RIVER AREA
1924
SCALE OF MILES
PROPOSED PINE FLAT RESERVOIR
San Joaquin River
CLOVIS
PIEDRA
FRESNO
MENDOTA
SANGER
FOWLER
REEDLEY
ORANGE COVE
SELMA
DINUBA
KINGSBURG
TRANQUILLITY
SAN JOAQUIN
HANFORD
LEMOORE
STRATFORD
CORCORAN
FOOTHILL
CONSOLIDATED
ALTA
JAMES
CRESCENT
PEOPLES DITCH AREA
LUCERNE
LEMOORE
CORCORAN
LAKELANDS
TULARE LAKE WATER STORAGE DISTRICT
RIVER GAGING STATIONS
① U S G S STATION AT PIEDRA
② OLD SANGER STATION
③ BELOW PEOPLES WEIR
④ BURREL AT ELKHORN GRADE
⑤ GREEN SLOUGH
⑥ CLARKS FORK
⑦ SAN JOSE SLOUGH
⑧ BELOW EMPIRE WEIR Nº 2
⑨ BELOW LEMOORE WEIR (PROPOSED)
⑩ TULE RIVER
⑪ ⑫ ⑬ CROSS CREEK EAST BRANCH MIDDLE BRANCH WEST BRANCH
⑭ KERN RIVER (NOT ON THIS MAP)

PLATE 16.

5. Ascertainment of flow into Tulare Lake from sources other than Kings River.
6. Investigation of seepage losses and return water in Kings River Channel.
7. Maintenance of automatic water stage recorder on Kings River at Piedra.

In previous biennial reports of the Division and in Bulletin No. 2 "Kings River Investigation" the physical and historical aspects of the situation are described in some detail, as are the various phases of the Division's work on Kings River up to and including the preceding biennial period. The text of the agreement providing for the schedule and of the schedule itself as well as a map of the area are available in these publications and will therefore not be repeated in this report.

New Activities During Biennium.

During the current report period two new activities undertaken in connection with the water master service on Kings River are worthy of mention. These are the construction of weirs on the lower river and the establishment of snowfall stations in the mountains.

Construction of Dutch John Cut and Cole Slough Weirs.

Kings River divides into two channels about four miles northeasterly from Laton, the northerly one known as Cole Slough and the southerly one known as Dutch John Cut. These two unite again at Laton to form the main river canal. The Grant, "A," Liberty and Murphy Slough canals divert from Cole Slough and the Last Chance Canal diverts from Dutch John Cut.

In the year 1923, it was observed that Cole Slough was not receiving enough water at low and medium stages of the river to supply the schedule allotments of the canals diverting from it. There were numerous complaints of shortage of water from the ditch superintendents and water users. The situation grew worse as the river receded. The water master called a meeting of the directors of the Laguna Irrigation District, Riverdale Irrigation District, Murphy Slough Association, and Liberty Canal Company, explained the cause of the water shortage to them, and recommended as a solution the construction of control weirs at the head of the river channels. His recommendation was accepted, but inasmuch as the Last Chance was also vitally interested the matter was likewise placed before them. They also accepted the recommendation.

At a joint meeting in Hanford the interests on both channels instructed their respective attorneys to prepare an agreement providing for the construction, operation, and maintenance of control weirs, division of the water, purchase of rights of way, etc.

After numerous meetings and conferences the agreement was accepted and signed by all the parties on April 1, 1924. The weirs were constructed in the autumn of 1925 under the supervision of the water master at a cost of $14,000.

Snowfall Stations in the Mountains.

An increasing demand from water users in the Kings River area for advance information as to the probable run-off of the river during the spring and summer months has led the Kings River water master and Mr. W. E. Bonnett, meteorologist, U. S. Weather Bureau, Fresno, California, to cooperate in the establishment of snowfall stations in the high mountain watershed of Kings River.

It is obvious that on a rough mountainous watershed it is impracticable to determine the acre-feet of water in the snow fields and thus estimate the probable net amount that will find its way into the streams. As an alternative there has been adopted the percentage method which is merely the determination of the percentage relationship of the seasonal snow cover of any given basin or region to the normal with the assumption that such percentage is indicative of the percentage of the following seasonal run-off in the streams below.

The record at Camp Seven Station which was abandoned two years ago after having been maintained for eight years by the U. S. Weather Bureau—when compared with the run-off of the river for the various seasons—shows that a very dependable relationship does exist. New stations for making spring depth and density measurements of the accumulated snowfall were established in Kaiser Meadow (elevation 9100 feet), Log Corral Meadow (elevation 7200 feet) and Panther Meadow (elevation 8650 feet). Kaiser Meadow is in the San Joaquin watershed and observations at this station will be made by employees of the Southern California Edison Company. Log Corral Meadow is in the Kings River watershed and Panther Meadow is in the Kaweah River watershed. Observations at both of these latter stations will be made by U. S. National Park rangers under the supervision of Col. John R. White, Superintendent of Sequoia and General Grant National Parks.

Daily precipitation measurements are being made at Florence Lake and Huntington Lake by the Southern California Edison Company, at Sequoia Park and General Grant National Park Headquarters by rangers and at Central Camp Sugar Pine Lumber Company by the U. S. Weather Bureau. The San Joaquin Light and Power Corporation for several years past has been keeping precipitation records at several stations on the watershed of the North Fork of Kings River. These records have been made available monthly to the water master.

In addition to the stations enumerated above, records are being kept at a number of other stations in the low mountain and foothill area. The cooperation of the power companies, National Park Service, National Forest Service and others has been most cordial. These courtesies are acknowledged.

Portions of the Sierra Nevada above 10,000 feet in elevation are uninhabited and largely inaccessible during the winter season. Stations in desirable localities where daily records can be maintained are too expensive to be undertaken with the funds available from state or federal governmental agencies. However, with the extension of power development a few locations will become available from time to time at diversion dams, tunnel intakes, etc., where employees are constantly on duty. Practically the entire area is in the national forests. It is understood that the permittees for power development are required to make certain stream flow records and obtain run-off data, by standard methods and under the supervision of the U. S. Geological Survey. A like requirement should be made for obtaining precipitation records by standard methods and under competent supervision.

CHAPTER VII.

UNDERGROUND WATER INVESTIGATION IN SOUTHERN SAN JOAQUIN VALLEY.

The subject of underground water has become within the last few years one of vital importance to many sections. This is particularly true in the southern portion of the state where most of the surface supplies were appropriated many years ago and the extension of irrigation could therefore be carried on only through development of underground supplies.

By far the greater part of the use of underground water for irrigation has come about in the last fifteen years. United States census figures show that whereas 351,000 acres, or 13 per cent of the irrigated area of the state, were served from underground sources in 1909, there were 868,000 acres or 20 per cent of the irrigated lands so served in 1919. The total irrigated area nearly doubled in this ten-year period while that supplied from underground sources more than doubled.

All but a comparatively small portion of such development has taken place south of the point where the San Joaquin River emerges from the foothills near the city of Fresno. This is accounted for by the fact that north of this point the surface flow of the rivers and streams has been sufficient to provide gravity water for the bulk of the land for which an irrigation supply was wanted. The progressive increase in aridity from the northern end of the state toward the south is marked in the San Joaquin Valley. Assuming a natual division of the valley into two parts—the southern part consisting of Kern, Kings, Tulare and Fresno counties and including the Kern, Kings and Kaweah rivers; the northern section including the balance of the valley to the city of Stockton and all streams from the San Joaquin to the Mokelumne rivers—the following comparisons of drainage areas, stream flows and agricultural lands are illuminating. The combined drainage area of the streams north of Kings River is 7700 square miles and of those from Kings River southward, 4900 square miles; total, 12,500 square miles. The mean annual run-off from the total drainage area approximates 12,000,000 acre-feet per year of which 8,700,000 occurs in the northern section and 3,300,000 in the southern. In other words the southern portion of the Sierras whose area is nearly seven-tenths as large as the northern yields but slightly over a third as much water in the form of stream discharge. The flow in the southern streams in addition to being smaller per unit of drainage area than in those farther north is also subject to much wider fluctuations and is therefore much more difficult to regulate and put to use.

The total agricultural lands of the valley including the foothill area is given as 8,200,000 acres of which about 4,700,000 or nearly 60 per cent are in the four southern counties; therefore, 60 per cent of the agricultural lands in the San Joaquin Valley have naturally tributary to them less than 30 per cent of the water supply.

Development of irrigation has, however, been more rapid in the southern section than in the northern. The 1919 census figures give the acreage irrigated in the four southern counties as 1,357,000 and in the balance of the valley as 733,000. While these figures would not be correct for the present time they bring out the fact that irrigation development in the southern end of the valley preceded that in the northern. Data are not available as to the percentages of these areas which were irrigated from surface and underground supplies. However, it is known that there is only a small area irrigated from underground sources in the northern end of the valley and that for many years practically all extension of irrigation in the southern half has been by this means.

Meteorological and geological conditions have thus combined to force the counties of Kern, Kings, Tulare and Fresno to depend largely upon underground supplies of water for irrigation use. The Kings, Kern and Kaweah rivers and secondary streams were diverted and used as far as possible without storage by the early settlers and no material extension of irrigation has been possible by this means for the past twenty years which condition has naturally led to extensive use of underground water supplies where available.

Increased pumping lifts and the realization that in some areas the annual withdrawal of the water has equalled if not exceeded replenishment has directed the attention of the valley and the public offices connected with water and irrigation development to the situation and it has been under more or less incomplete and intermittent study for some years. The first report of any importance was Water-Supply Paper No. 398 issued in 1916 by the Geological Survey entitled "Ground Water in San Joaquin Valley." In 1920 the State Department of Engineering in cooperation with Kern and Tulare counties and other interests made investigations of local ground water resources the results of which were published for Kern County as Bulletin No. 9 of the State Department of Engineering and for Tulare County as Bulletin No. 3 for the Division of Engineering and Irrigation. On Kings River a number of the larger irrigation districts and canal companies have been keeping records of ground water fluctuations in their respective areas which records extend back over varying periods from one to five years.

Interest in the underground water situation in this section has been accentuated by dry years and the consequent heavier draft on the basins. Extensive new developments of ground water are under way notably on the west side in Fresno County, in the Tulare Lake basin and in the duck club area northwest of Wasco. The importance of ascertaining the actual conditions confronting the valley became so great that in the summer of 1925 local valley interests requested the state through the Division of Water Rights and the Division of Engineering to institute and carry on a comprehensive study of the underground water situation in the entire southern San Joaquin Valley and to connect up and coordinate the many isolated or local efforts which were being made. The subject being of particular interest to both offices after preliminary study and field inspection such an investigation as was thought best designed to meet the conditions was laid out and undertaken. Funds to the extent of $5,000 a year were supplied jointly by the Division of Water Rights and the Division of Engineering and Irrigation. The field work was placed in charge of Mr. C. L. Kaupke, water master for the Division of Water Rights on Kings River.

The amount of work which the state can do directly with this amount of money is, of course, limited, it being practically sufficient only for the time and expense of one engineer continuously in the field. The preliminary investigation indicated, however, that a great deal of the necessary work was already being carried on by the various districts, water companies, power companies and others in the various localities. These efforts have been standardized and coordinated under the direction of the state; other districts have been induced to take up the collection of such data, and the areas in which no such records are being collected have been reduced to a minimum.

The preliminary survey of the valley revealed that the largest areas in the valley in which no ground water observations were being made were in the Kings River territory and on the west side extending from Mendota to Buena Vista Lake in which latter territory very little ground water data were available. The field work under the direction of the Division has therefore been mainly directed toward those areas not under observation by private parties. The work has been under way something more than a year and funds are in sight to continue it until the end of the present biennium. It should not, however, be allowed to lapse at that time but should continue indefinitely in order to produce the results for which the investigation was outlined.

The data on file in connection with this investigation is at the present time being correlated and analyzed with a view to issuing a bulletin which will make public the data so far collected with such comment as can be made. This publication will appear as Bulletin No. 11 of the Divisions of Engineering and Irrigation and of Water Rights under the title of "Ground Water Resources of Southern San Joaquin Valley" and will probably be available by the time this report is in print.

CHAPTER VIII.

SAN GABRIEL INVESTIGATION.

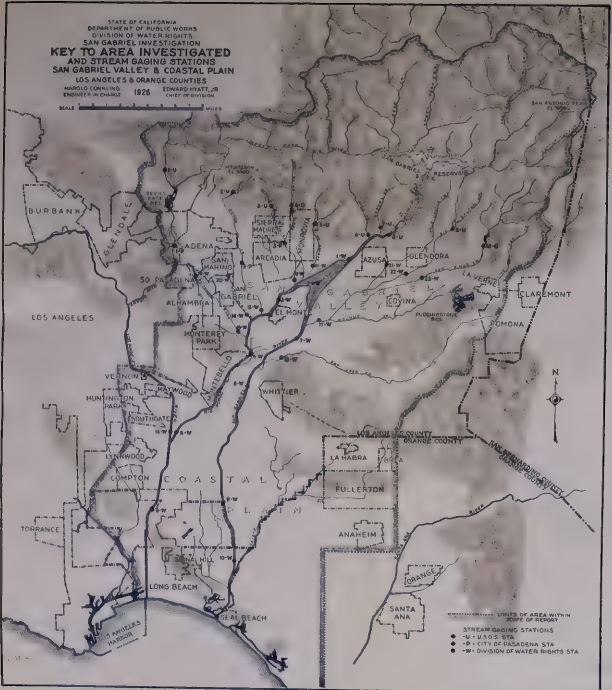
The further development of the water resources of San Gabriel Basin in the eastern half of Los Angeles County presents problems of the greatest difficulty. Not only have the lands of the valley been brought by intensive cultivation into production of the most valuable citrus crops but also there are numerous cities and towns of importance within its borders in addition to a very large residential population outside incorporated territory. Under these conditions the value of water and water rights has come to exceed that in any similar locality in the state which statement would doubtless include the rest of the world as well.

San Gabriel Valley being favored by all natural conditions for citrus orchards and being contiguous to the city of Los Angeles reached practically full development from unregulated stream flow many years ago. The principal source of supply is San Gabriel River which traverses the approximate center of the basin from northeast to southwest. There are also several secondary streams but these are of minor importance. The summer flow of the streams tributary to the valley being small this source quickly exhausted. Litigation between opposing claimants resulted in rights to the natural flow being finally established by court decree on all important sources. Most of these controversies were settled thirty or more years ago. Development since then has been mainly by use of underground water, of which there was a vast and seemingly unlimited supply. It has proved to be limited, however, particularly in many of the sub-basins on the edge of the San Gabriel Basin proper, and some areas have suffered depletion and shortage.

In common with other Southern California streams, San Gabriel River is irregular as to flow, being subject to floods of great magnitude in some years and to extreme drought in others. This condition was, of course, unfavorable to irrigation development depending on surface flow of the river, but forced reliance on the underflow, since the great underground basin would refill during the years of floods and retain this supply to be pumped out during the succeeding dry seasons.

Storage in surface reservoirs has been until recent years impractical on account of the irregular character of the run-off which would necessitate a very large reservoir to carry the floodwaters over for several dry years and also to the lack of economical reservoir sites in San Gabriel Canyon. The rapidly increasing value of water coupled with the recurrence of great floods wasting into the ocean has however served to focus public attention upon this river as a possible source of water supply for new uses.

The situation was first formally brought to the attention of the State Water Commission in 1918 when an application to appropriate excess waters of San Gabriel River for agricultural purposes was filed. Since then the matter has been under almost continuous study by private and public interests. Questions confronting the state office were not and are not today simple. The mere fact that water has run into the ocean winters and always in a major flood does not itself indicate to what extent or under what conditions unappropriated water is available, if at all. Rights have been established by users from the under-



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RIGHTS
SAN GABRIEL INVESTIGATION

KEY TO AREA INVESTIGATED
AND STREAM GAGING STATIONS
SAN GABRIEL VALLEY & COASTAL PLAIN

LOS ANGELES & ORANGE COUNTIES

HAROLD CONKLING
ENGINEER IN CHARGE

1926

EDWARD HYATT, JR
CHIEF OF DIVISION

47854

flow which is replenished by these very floods and these rights as well as all others prior and vested must be respected. The operation of flood control reservoirs now under construction by Los Angeles County will materially change the regimen of the streams below such reservoirs, which raises a multitude of questions, both physical and legal.

When the San Gabriel problem was first investigated by the State Water Commission in 1919 it was found that knowledge of the physical facts regarding the situation in general and water supply in particular were lacking to an astonishing degree, considering the progressiveness of the valley in all other lines. Little was known about the one vital resource, water. The Geological Survey had maintained a gaging station at the mouth of the canyon for some years and the flow at this point was known within reasonable limits but this was all. As to conditions surrounding percolation, use of underground water, flow into the ocean, character of main and sub-basins little if anything was available. The Commission concluded that no proper answer to the applications filed could be given without a thorough hydrographic investigation of the watershed and so advised the applicants and other interested parties.

With the filing in 1923 by the city of Pasadena of applications to store and divert excess waters of San Gabriel River for municipal use in that city the necessity for the investigation was given new impetus, and the needed study was finally started July 1, 1923, under the direction of the Division of Water Rights and in immediate charge of Harold Conkling, hydraulic engineer. It has now been in progress three and one-half years and will be continued for at least one more season.

Financing of Investigation.

The work has been financed mainly through contributions from applicants, from the Los Angeles County Flood Control District and from other interested parties. The Division of Water Rights has furnished general supervision, automobiles and equipment and has appropriated $5,000 toward the work. Pasadena financed the work almost entirely from its inception in July, 1923, to December, 1924. An additional amount of $750 was appropriated during this period by a group of water companies south of Covina called the Hollenbeck Street, Valencia and Valencia Heights water companies. Since December, 1924, the investigation has been carried mainly from funds advanced by the Flood Control District of Los Angeles County, the district having made appropriations for carrying forward certain phases of the work under contract with the Division.

There is in course of publication a report on this work which will make public all data collected up to September 30, 1926, together with such deductions therefrom as seem demonstrable. This report will be issued as "Bulletin No. 5, Division of Water Rights," under the title of "San Gabriel Investigation" and should be publicly available before this is in print. The physiography and hydrography of San Gabriel Basin were discussed in Chapter IX of the last biennial report of the Division. Referring to these two publications for the details of the work the following summary of the physical situation and of progress in the biennium is given.

Physical Situation.

San Gabriel Basin divides naturally into three areas, the mountain area of 280 square miles, San Gabriel Valley consisting of 203 square miles of alluvial valley and 77 square miles of hills and foothills more or less habitable, and the Coastal Plain, a flat alluvial slope into which Los Angeles River flows on the west and Santa Ana River on the east of the San Gabriel River so that the area of influence of the San Gabriel River is difficult to delimit. The division between the Coastal Plain and the Valley is accomplished by a range of mountains or hills around the bases of which debris washed down from the San Gabriel mountains has piled until this barrier rises only about 1000 feet above the plain at the highest point. San Gabriel River has cut a pass called Paso de Bartolo or Whittier Narrows through this barrier.

Water discharging from the mountains both in the river and in its tributaries percolate in part into the valley fill and then, slowly drifting toward the Narrows, is forced to the surface at the Narrows in a perennial stream. It sinks again below this barrier and flowing underground impinges on another barrier of hills bordering the ocean where it is again brought to the surface. Plate 17 affords a general view of the situation.

San Gabriel Valley is not a simple basin but contains several subbasins along the mountains the largest of which is Raymond Basin. These basins are separated underground by faults or "dikes" which hold the water at different elevations. The underground movement of water in San Gabriel Valley is in general by percolation but in the Coastal Plain large artesian aquifers have been laid down, and over a considerable part of the plain movement of underground water is by transmission of pressure, free movement to the ocean being cut off by the range of outlying hills just referred to. Otherwise the situation is the same in the valley as in the plain. Water percolates into the ground in the upper end of each and is brought to the surface by an underground barrier at the lower end. It is because of the flatter slopes that a greater relative amount of fine material has been deposited in the plain and artesian conditions predominate, while in the valley such conditions are confined to the small areas along the barrier hills and above Raymond Hill dike.

Scope of Investigation.

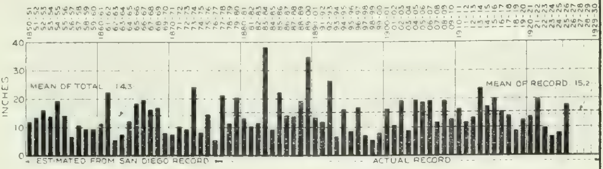
All possible features are being covered: geology, percolation from stream beds, well measurements, movement of underground waters, evaporation from moist areas, present and ultimate demands, areas irrigated and possible to irrigate. In a word a solution of the problem of how best to conserve and utilize the water supply of the basin is being sought. The solution requires:

(1) Knowledge of how much water goes to waste.

(2) Knowledge of how much is now required and will ultimately be required.

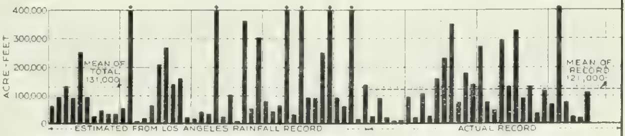
(3) Knowledge of movement of the underground water in order to determine in what part of the underground structure it can best be conserved and how much it is feasible to conserve.

It is expected that with the conclusion of the investigation such knowledge will be available approximately and the problem of the fullest conservation may be more intelligently attacked.



PRECIPITATION AT LOS ANGELES

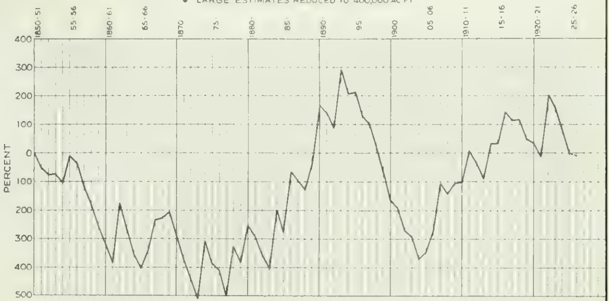
SEASONAL YEAR JUL 1ST TO JUN 30TH



DISCHARGE OF SAN GABRIEL RIVER

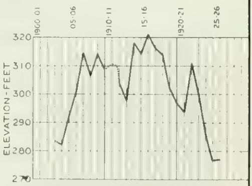
SEASONAL YEAR - OCT. 1ST TO SEP. 30TH

• LARGE ESTIMATES REDUCED TO 400,000 AC FT



ACCUMULATED VARIATION IN PERCENT OF ANNUAL MEAN DISCHARGE OF SAN GABRIEL RIVER

SEASONAL YEAR - OCT. 1ST TO SEP. 30TH



ANNUAL CHANGE IN WATER LEVEL, WELL 294-F

SAN GABRIEL VALLEY

SEASONAL YEAR - OCT. 1ST TO SEP. 30TH

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RIGHTS
SAN GABRIEL INVESTIGATION

HYDROLOGICAL DIAGRAMS

HAROLD CONKLING
ENGINEER IN CHARGE

EDWARD HYATT JR
CHIEF OF DIVISION

PLATE 18.

Progress During Biennium.

Measurements of run-off and well measurements have continued during the past two years. A geological report on the basin has been completed.

The seasons 1923–24 and 1924–25 were extremely dry and the data secured while valuable in showing what can be expected in dry years were negative in value in other respects. The year 1925–26 bade fair to be as dry as the preceding seasons until April 4–8, 1926, when a rain of unprecedented volume for that season occurred. Water levels prior to that time had receded to the lowest levels in history but were replenished to some extent.

However, on October 1, 1926, at the close of the water year water levels were lower in most parts of the valley and Coastal Plain than they had been a year before. Exceptions to this condition were found in the upper part of the Pasadena Basin where about 4000 acre-feet were conserved by Devils Gate Reservoir and reached the underflow, and at the mouth of San Gabriel Canyon where spreading had filled the basin and where a greater surface flow from the canyon resulted in a smaller pumping draft on the underground supply than usual.

Percolation Studies.

The flood of April, 1926, reached a peak of 14,900 second-feet and gave opportunity to get the best results on percolation in the stream so far obtained during the investigation. The principal area in which percolation takes place is in the cone from the city of El Monte north. When the watertable is as low as in 1926 opportunity for percolation is increased because the watertable intercepted the stream bed several miles further south in 1926 than it did in such a year as 1916 when the watertable was the highest on record. Under such conditions of high watertable, the basin at the mouth of the canyon also fills up, therefore at such a time the length of stream channel in which percolation opportunity exists is shortened at both ends. The ratio of length of channel with high watertable to that with the low watertable of 1926 is about 35 per cent. Results in 1926 indicate the possibility that, with channel conditions as they were in 1926, and water levels as of 1916 percolation would have been about ⅓ of that observed.

Observed rates of percolation in San Gabriel Wash vary from about 4.75 second-feet per acre around El Monte where the channel is sandy to 0.90 second-foot per acre near the head of the cone.

Percolation in Coastal Plain is not as large per unit or in total quantity as in San Gabriel Valley. The net quantity appears to be about 100 second-feet.

TABLE 6.

Summary of Results, San Gabriel Valley, 1923–24.

Average precipitation 11.11" or 63% of normal.	*Acre-feet*
Mountain run-off	24,400
Precipitation on valley floor	105,000
Storm water passing Narrows	2,500

1924–25.

Average precipitation 11.78" or 66% of normal.	
Mountain run-off	32,000
Precipitation on valley floor	126,000
Storm water passing Narrows	5,000

1925–26.

Average precipitation 20.35" or 114% of normal.	
Mountain run-off	153,000
Precipitation on valley floor	220,000
Storm water passing Narrows	55,300

CHAPTER IX.

SACRAMENTO AND SAN JOAQUIN RIVERS.

PART 1.

SECOND SACRAMENTO-SAN JOAQUIN RIVER PROBLEMS CONFERENCE.

In the Division's Biennial Report of November 1, 1924, description was given in Chapter X of the First Sacramento-San Joaquin River Problems Conference and Chapter XI of that report presented the work of the Sacramento-San Joaquin Water Supervisor for 1924, an outcome of the First River Problems Conference. The proceedings of the first conference were also published and widely distributed. It is unnecessary, therefore, to enlarge upon the history of the first conference and the work accomplished in 1924 by its Permanent Committee working with the Division of Water Rights.

The Problems Involved.

The problems calling forth the conference and furnishing impetus to subsequent steps may be briefly summarized: Appropriative and other water rights on the Sacramento River between the city of Sacramento and Red Bluff total from 5800 to 6000 second-feet; water requirements both for irrigation and salinity control in the great delta of the Sacramento and San Joaquin rivers lie in the neighborhood of 3500 second-feet or more; an estimated flow of from 3000 to 3500 second-feet is needed in the Sacramento River above Sacramento in the maintenance of navigation; to satisfy these requirements and water rights there has been only an actual available flow in the Sacramento River at Red Bluff of from 3000 to 3500 second-feet after July 1st in four of the last seven seasons and a summer flow to the delta from the San Joaquin River of less than 1000 second-feet.

The total of permits to appropriate from the Sacramento River, Red Bluff to Sacramento, as granted by the Division of Water Rights, is 5300 second-feet. Development under these permits to date indicates that they will probably vest to rights of about 3800 or 4000 second-feet. Old appropriative rights (initiated prior to the Water Commission Act) and used riparian rights, for the same stretch of river, are estimated at 2000 second-feet, making the total rights of 5800 to 6000 second-feet as first stated.

In years of normal rainfall and stream flow, difficulties from this situation have not been critical. In such seasons as those of 1920, 1924 and 1926, however, the necessity for such an organization as the River Problems Conference has been urgent and justification for its work obvious.

The Call for the Second Conference.

In accordance with a resolution adopted at the first conference that the conference be made permanent and its meetings subject to the call of the Division of Water Rights, the second conference was called by the Division on December 12, 1924. The presentation of the Permanent Committee's recomendations, its report on the work accomplished during the 1924 season, and a general discussion of plans for the future were the chief considerations urging the call at this time. Invitations were sent throughout the state to those prominent in water matters and a most representative gathering numbering more than two hundred people was in attendance. The reports, discussions, and papers occupied three sessions—morning, afternoon and evening—the latter following a banquet. An outline of the program is given in the following:

OUTLINE OF SECOND SACRAMENTO-SAN JOAQUIN RIVER PROBLEMS CONFERENCE.

Morning Session.

Opening Address-------Edward Hyatt, Jr., Chief, State Division of Water Rights
Welcome by Sacramento Chamber of Commerce------------Herman Davis, Vice President, Sacramento Chamber of Commerce
Statement by Conference Committee Chairman-------G. J. Bradley, Chairman, Permanent Committee of the Sacramento-SanJoaquin River Problems Conference
Report of Sacramento-San Joaquin Water Supervisor------------Harlowe M. Stafford, Water Supervisor
Duty of Water Investigations------------Frank Adams, Irrigation Investigations, U. S. Department of Agriculture and University of California
Recommendations of the Permanent Conference Committee------------G. J. Bradley, Committee Chairman

Afternoon Session.

Review of 1924 Season's Work—

(a) William Durbrow, President, Glenn-Colusa Irrigation District and California Irrigation District Association
(b) G. A. Atherton, General Manager, California Delta Farms, Inc.

Open Discussion of Water Problems—

C. A. Barlow, President California State Irrigation Association
W. P. Boone, Chairman Executive Committee, Pine Flat Project, "A Review of Irrigation Development and Water Right Litigation in the San Joaquin Valley"
F. E. Woodley, Los Angeles County Supervisor
G. W. Dwinell, Montague, Siskiyou County
H. J. Evans, Vice President California State Irrigation Association
W. A. Irving, Riverside, California
H. W. Dennis, Chief Engineer, Southern California Edison Company
D. O. Castle, President Board of Directors, South San Joaquin Irrigation District
H. A. Storrs, Chief Engineer, Modesto Irrigation District
S. P. Pitt, Manager, Princeton-Codora-Glenn Irrigation District
W. Lehmkuhl, Chief Engineer, Waterford Irrigation District
H. L. Haehl, Consulting Engineer, San Francisco
Senator L. L. Dennett, Modesto
Senator John Creighton, Bakersfield.
Assemblyman Van Bernard, Butte City
Assemblyman Roscoe J. Anderson, Redding
Assemblyman B. S. Crittenden, Tracy
Assemblyman Frank W. Mixter, Exeter
Assemblyman T. S. Louttit, Stockton
William Hood, Ex-Chief Engineer Southern Pacific Company
Dan Hadsell, San Francisco, Attorney for Delta interests

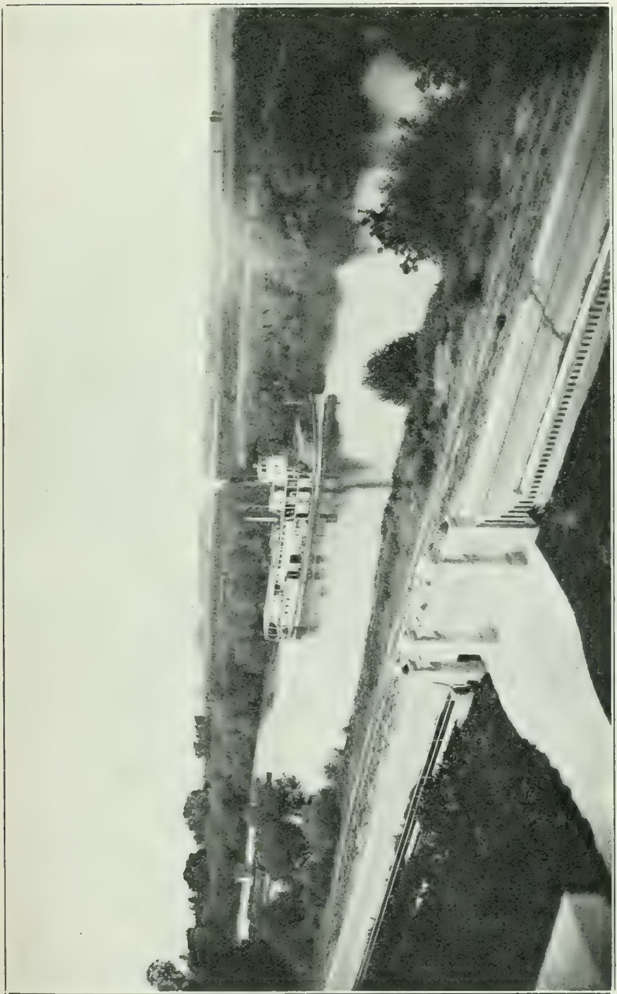
Report of Resolutions Committee------------Alden Anderson, Chairman

Evening Session.

Adoption of Recommendation II Referred to Evening Session
Presentation of Gift to Permanent Committee Chairman

Addresses—

Status of Investigations for the Salt Water Restraining Dam, Walker R. Young, Engineer, U. S. Bureau of Reclamation
Water Resources of the Great Central Valley, Paul Bailey, Deputy Chief, State Division of Engineering and Irrigation.
The Mokelumne River Project of the East Bay Municipal Utility District as Related to the Development of the Great Valley of California, Arthur Powell Davis, Chief Engineer and General Manager, East Bay Municipal Utility District.
General Comment, Honorable Friend Wm. Richardson, Governor of the State of California



ALONG THE VICTORY HIGHWAY IN THE SACRAMENTO RIVER DELTA.

Reports place the value of the 1925 shipping on the Sacramento-San Joaquin waterways at $127,694,000.

PLATE 19.

Conservation as Related to Navigation. U. S. Grant. 3d. Major Corps of Engineers. U. S. Army. District Engineer, Second District. San Francisco
Detrimental Effects of Salt Water on Industries. C. W. Schedler. General Manager, Great Western Electro-Chemical Company. Pittsburg

Recommendations and Resolutions Adopted.

The recommendations of the Permanent Committee and resolutions adopted by the Second Conference were most noteworthy, and should be given a careful reading by every one interested in water matters in the state. Considerable space would be required to present the recommendations and resolutions in full in this report and as they have been printed and widely distributed in Bulletin No. 4. "Proceedings of the Second Sacramento-San Joaquin River Problems Conference and Water Supervisor's Report, 1924" repetition will be avoided by reference to the above named bulletin.

It is to be particularly noted that under the resolutions adopted, the Conference voted to continue its Permanent Committee. Since the Second Conference, therefore, this committee has continued to be active and during the 1925 and 1926 irrigation seasons has met a number of times upon river matters and questions raised in connection with the administration of Sacramento and San Joaquin waters by the Water Supervisor of the Division of Water Rights.

Appropriation for Water Supervisor Work.

Pursuant to recommendation V adopted by the Second Conference, that state funds be appropriated for a continuation of the work of the Water Supervisor, the Permanent Committee carried this matter to the 1925 legislature and an appropriation was included in the budget of the Division of Water Rights providing for the continuation of the work until July 1, 1927.

Progress.

With the drawing to a close of the third season's operation under the methods and plans initiated by the first Sacramento-San Joaquin River Problems Conference including the work of the Water Supervisor based upon the 1924 Water Users Agreement, a good opportunity is presented to review such progress as may have been made in dealing with the Sacramento-San Joaquin water problems. Such a review at this time would seem to indicate an advancement most satisfactory to all concerned and one predicting well for the future.

Of prime importance, the efforts to date have come as a result of, and have strengthened, the spirit of cooperation, welding together the various diverse interests so as to make the best of the situation and avoid expensive and extended litigation. Following the so-called Antioch Suit one of much greater proportions has been filed. The loss in time, money and retarded development which would be entailed by the trial of this suit is fearful to contemplate. But with the action of the River Problems Conference, the Permanent Committee and the state, this suit has not been pressed.

In the River Problems Conference and its Permanent Committee, there has been created a most fortunate medium for dealing with the problems involved; and at present, the Committee, influential and representative, stands ready as the proper body to forward all constructive plans for bettering the river situation.

Since the appointment of the original Committee of Nine by the First Conference, there have been some changes and additions so that

FIELD OF RICE, NATOMAS DISTRICT, SACRAMENTO VALLEY.

The heads are well turned down and the field has just been drained preparatory to harvest. The 1926 Sacramento Valley rice crop is estimated at three and one-half million bags or approximately a ten million dollar yield.

PLATE 20.

at present the membership and representation is as follows: Herbert E. White, acting chairman, Sacramento, attorney, and Alden Anderson, Sacramento, chairman board of directors Capital National Bank, representing Sacramento interests; E. L. Adams, Chico, president California Rice Growers Association, representing Feather River interests; A. E. Anderson, San Francisco, president California Transportation Company, representing navigation interests; G. A. Atherton, Stockton, general manager California Delta Farms, Inc., representing San Joaquin Delta interests; P. M. Downing, San Francisco, vice president Pacific Gas and Electric Company, representing power interests; William Durbrow, Willows, secretary-manager Glenn-Colusa Irrigation District and Jesse Poundstone, Grimes, president Reclamation District 108, representing Sacramento River interests (above Sacramento); Manly S. Harris, San Francisco, president Motor Body Corporation, representing duck club interests; W. I. Hechtman, Sacramento, manager W. A. Curtis Estate, representing Sacramento Delta interests; Warren H. McBryde, San Francisco, secretary California-Hawaiian Sugar Refining Corporation, representing San Francisco and industrial interests; R. V. Meikle, Turlock, chief engineer Turlock Irrigation District, representing San Joaquin River interests (East Side); and F. T. Robson, Vina, secretary Stanford Vina Ranch Irrigation Company, representing Upper Sacramento Valley interests.

CUTTING ASPARAGUS IN THE SACRAMENTO RIVER DELTA.

The "shoots" in the foreground were purposely left for the picture. When exposed to the sun "green asparagus" results. The tips only of that being cut are exposed thus giving "white asparagus" for canning. It is claimed that 90 per cent of the world's canned asparagus is produced in the Delta Region.

PLATE 21.

George J. Bradley, chairman of the committee from the time of its appointment, was called by death on March 16, 1926. In his passing the committeee lost a most efficient, energetic, impartial and courageous leader and one whose wholehearted efforts in the interests of the Sacramento and San Joaquin valleys will not soon be forgotten.

PART 2.

SACRAMENTO-SAN JOAQUIN WATER SUPERVISOR.

As outlined in Part 1 of this chapter, in accordance with a recommendation and resolution passed by the Second Sacramento-San Joaquin River Problems Conference and at the instance of the Permanent Committee of that conference, provision was made by the 1925 legislature for the continuation of the work of the Sacramento-San Joaquin Water Supervisor, the appropriation included in the budget of the Division of Water Rights insuring its continuation until July 1, 1927. In the preceding Biennial Report of the Division and also in Bulletin No. 4, "Proceedings of the Second Sacramento-San Joaquin River Problems Conference and Water Supervisor's Report, 1924," a complete description has been given of the history leading to the appointment of a Water Supervisor, the Water Users Agreement upon which the work of that office is based, and the conservation features and collection of records included in the 1924 season's work. The present part of this chapter is concerned with the work done and records obtained during the 1925 and 1926 irrigation seasons.

Applicability of Water Supervisor Procedure.

To briefly review the reasons for and basis of the work of the Water Supervisor, it should be kept in mind that the ultimate objective of all water legislation and administrative effort is the distribution of the water to those having a valid claim upon it. Where the water titles on a stream have been definitely decreed, this is readily accomplished through a State water master. Where, as in the Sacramento-San Joaquin situation, the water rights have not been definitely adjudicated, there are three courses open in striving to consummate a clearing of water titles prerequisite to the water master service. These are: (1) litigation, (2) the code provisions of the Water Commission Act, and (3) mutual agreement based upon investigations and determinations of physical fact. In 1925, in the Sacramento-San Joaquin territory, the use of water under the various classes of water rights was about as follows: For the Sacramento River and tributaries in the Valley above Sacramento, old appropriative rights 620,700 acre-feet appropriative rights under applications to and permits from the Division of Water Rights, 610,200 acre-feet, and presumably riparian rights 66,100 acre-feet. Of the 227,000 acres irrigated in the delta in 1925, a considerable portion is covered by appropriative filings before the Division and practically the entire delta area of more than 400,000 acres claims water under riparian rights. Under such conditions, with litigation naturally repellant, the third of the above mentioned courses becomes the one most practical and applicable to the Sacramento-San Joaquin situation. With the facts of water supply, actual water requirements and use definitely established through engineering investigation, experience has proven it perfectly feasible to base thereon mutual agreements either temporary to tide over an immediate crisis or more or less permanent, under which a water master or water supervisor may successfully distribute and conserve for the best interests of all, a deficient water supply. The Water Supervisor's authority and benefits to be derived from its exercise will extend only so far as the water users mutual agreements permit it.

Conservation Features.

During the irrigation seasons of 1925 and 1926, the conservation features of the Water Supervisor's work have included principally the efforts to insure sufficient flow in the Sacramento River above Sacramento to maintain navigation, and as great a flow to the delta as possible to prevent the encroachment of salt water. This work has been carried on almost entirely through appeals to the water users for waste prevention and reduction of diversions where possible. The conservation measures effected therefore have been purely voluntary and there has been no enforcement of any particular schedule of water diversions agreed upon by the water users themselves.

Efforts to Maintain Navigation—1925.

During the 1925 irrigation season there was no serious shortage of water for irrigation purposes but the flow in the Sacramento River between Colusa and Butte City and in the vicinity of Verona fell to a point where navigation was nearly prohibitive. This occurred in August. In response to a letter from the War Department under date of August 17th asking that further measures be taken to increase the flow for navigation, letters signed by the Permanent Committee were sent to approximately 150 irrigationists and 50 duck clubs north of Sacramento. These letters appealed for conservation and cutting down of diversions on the part of the irrigationists, and warned duck clubs that no diversions for filling their ponds could be expected until after September 15th. In following up this appeal it was found that nearly all of the large diverters of water for irrigation were making some response and effecting such savings as they could. On the other hand there was an indifferent response from the duck clubs. Some few clubs stated that they would defer filling their ponds, but in view of the fact that the majority were already filling or had filled theirs, these few were made to bear an unequal share of the response. At a meeting of the Permanent Committee on September 25, 1925, representatives of the War Department and the gun clubs were present and the situation respecting the use of water by the clubs was discussed. The representatives of the clubs expressed a desire to cooperate with the Committee and it was agreed that a solution to the major portion of the difficulties could probably be attained by effecting a change in the opening date for the duck shooting season from October 1st to October 15th.

Following the appeal for conservation to aid navigation in August, 1925, there was some improvement in the river flow but not in the amount required. On the other hand, without the efforts made just at this time a considerable reduction in flow might have occurred such as to entirely impair navigation.

Duck Shooting Season Changed as a Conservation Measure.

During the winter of 1925–26, petition was forwarded by the Permanent Committee to the United States Secretary of Agriculture asking

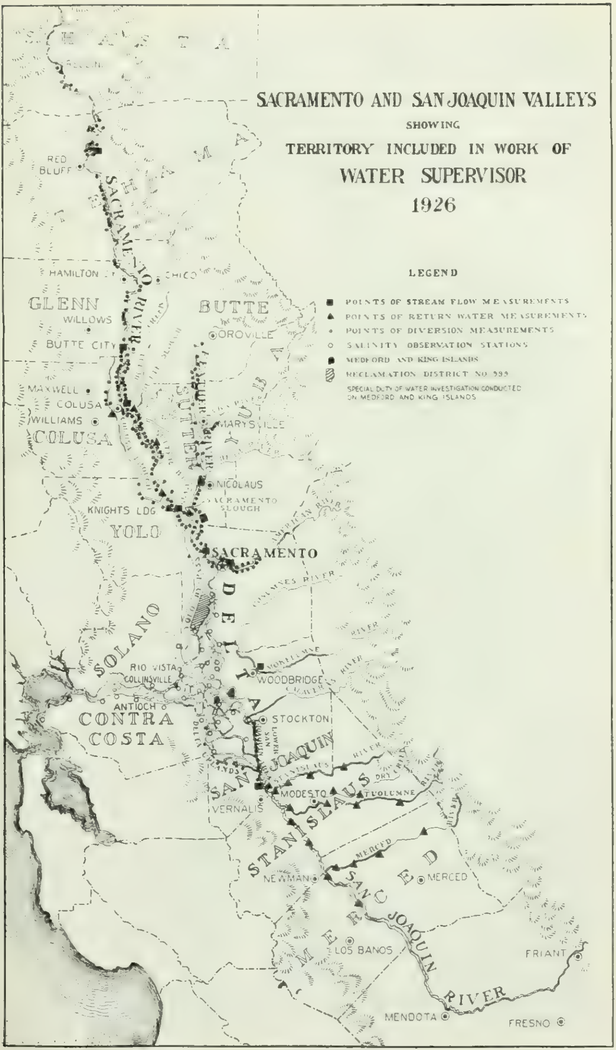

SACRAMENTO AND SAN JOAQUIN VALLEYS
SHOWING
TERRITORY INCLUDED IN WORK OF
WATER SUPERVISOR
1926
LEGEND
■ POINTS OF STREAM FLOW MEASUREMENTS
▲ POINTS OF RETURN WATER MEASUREMENTS
• POINTS OF DIVERSION MEASUREMENTS
○ SALINITY OBSERVATION STATIONS
● MEDFORD AND KING ISLANDS
▨ RECLAMATION DISTRICT NO 999
SPECIAL DUTY OF WATER INVESTIGATION CONDUCTED ON MEDFORD AND KING ISLANDS
SHASTA
TEHAMA
RED BLUFF
SACRAMENTO RIVER
HAMILTON
CHICO
GLENN
WILLOWS
BUTTE
OROVILLE
BUTTE CITY
FEATHER RIVER
YUBA
MAXWELL
COLUSA
WILLIAMS
SUTTER
MARYSVILLE
NICOLAUS
SACRAMENTO SLOUGH
KNIGHTS LDG.
YOLO
AMERICAN RIVER
SACRAMENTO
COSUMNES RIVER
DELTA
SOLANO
RIO VISTA
COLLINSVILLE
MOKELUMNE
WOODBRIDGE
ANTIOCH
CONTRA COSTA
STOCKTON
LOWER SAN JOAQUIN
SAN JOAQUIN
STANISLAUS RIVER
DRY CREEK
MODESTO
TUOLUMNE RIVER
VERNALIS
STANISLAUS
MERCED
MERCED
NEWMAN
SAN JOAQUIN RIVER
LOS BANOS
FRIANT
MENDOTA
FRESNO

PLATE 22.

that the duck shooting season for California be changed to the period October 15–February 1. The necessity for this change as a conservation measure was outlined to the secretary and supporting papers showing a favorable attitude to the change on the part of sportsmen and the California Fish and Game Commission were enclosed. In response to this petition word was received from Washington on June 24, 1926, that the open season on water fowl in California had been changed to the period October 16–January 31. In insuring that the duck clubs would commence their diversions later in the season, it was felt that this change would help the situation considerably.

The 1926 Situation.

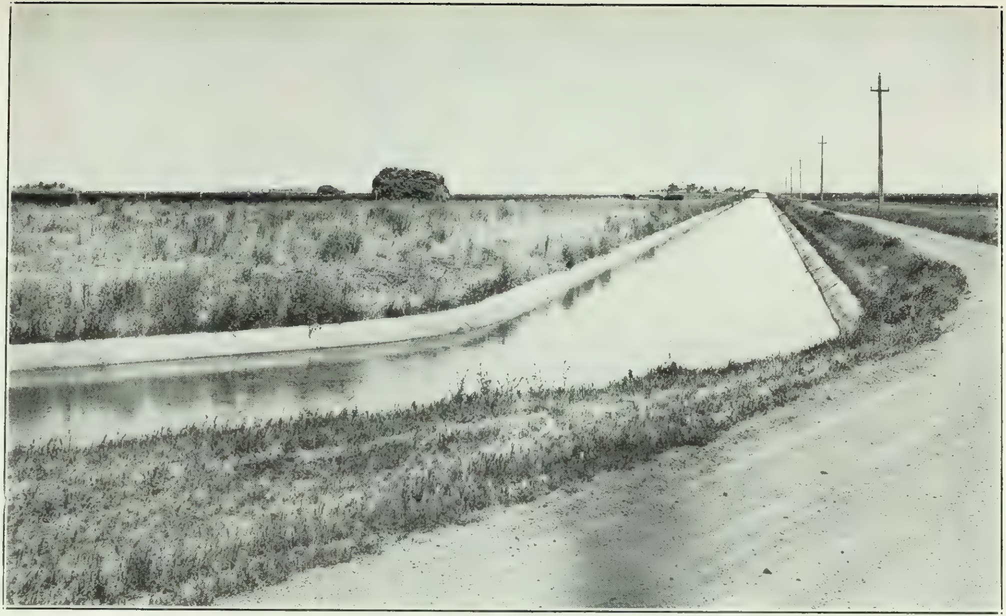
With a much larger rice acreage planted in 1926 than in the two previous years and the water supply very little better than in the 1924 season, a considerable effort in the way of waste prevention and water conservation was necessary. In the latter part of June, with the flow of the Sacrameto River dropping quite rapidly and down close to previous low water levels difficulty with navigation above Sacramento began to be encountered and letters were again received from Major C. S. Ridley, District Engineer for the War Department, requesting that measures be taken in an endeavor to insure additional water for the maintenance of navigation. In response, the Water Supervisor interviewed the representatives of all of the larger water users, requesting all possible reductions in diversions and advising that it would be required that waste and seepage be reduced to a minimum. This was followed by letters to all water users making any appreciable diversion. Feather River water users were included in this appeal.

A number of instances were found where waste could be prevented and in almost every case the water users appeared to be making a sincere effort to reduce their diversions to the minimum amount necessary to mature their crops. Letters from many of the larger users outlining the conservation measures taken were received and copies of these letters were forwarded to Major Ridley. In spite of the cooperation given, however, it was not possible to obtain sufficient flow to maintain navigation to or above Colusa until early in September. It would appear, therefore, that the limit of benefit to be derived through waste prevention and voluntary diversion reductions was reached and that in such seasons as that of 1926 additional water can only be obtained by more drastic measures necessitating the elimination of some of the areas watered.

In lower stretches of the Sacramento River in the vicinity of Verona and Knights Landing, an increase in flow beginning as early as the middle of August due to return water and an early completion of some rice diversions was soon effective in relieving the navigation situation and permitting a regular run of boats. With a continued increase in flow from the same causes, navigation to and above Colusa became possible about September 10th.

Duck Club Diversions—1926.

With a shortage of flow to the delta and insufficient water for navigation above Sacramento in 1926 the necessity of prohibiting diversions for gun club purposes again arose as in previous years. Although the



IRRIGATION IN THE DELTA UPLANDS.

Portion of the Main Canal of the East Contra Costa Irrigation District near Brentwood.

PLATE 23.

change in duck shooting season operated automatically to help considerably in this respect, there were some instances of early diversions. The clubs taking water were advised of the water situation and notified that diversions should be withheld until September. On August 5, 1926, these notices were further supported by a resolution of the Permanent Committee of the Sacramento-San Joaquin River Problems Conference. This resolution advised the gun clubs that unless compliance were made to the request for deferred diversions, it would be necessary to take legal steps to enjoin the use of water by the clubs. Subsequent to this action the full cooperation of all clubs was received.

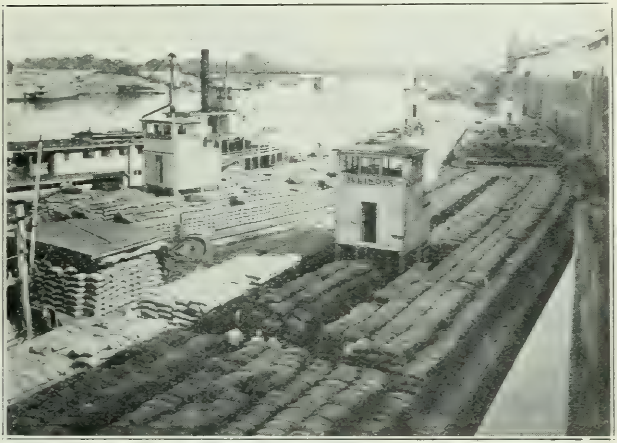
When, early in September, the flow of the Sacramento River at Sacramento increased to over 3000 second-feet, those gun clubs whose use of water would not affect the water stages in the vicinity of Colusa were notified that diversions could be commenced, and later, by September 10th, this notice was extended to all clubs.

Drainage of Butte Basin—1926.

Considerable effort was put forth by the Water Supervisor in 1926 to effect the complete draining of Butte Basin as a conservation measure. There is a considerable area between Butte Creek and the Marysville Buttes where winter floods are naturally impounded and the pondage is maintained through the summer by the inflow of drainage water from upper rice areas. This basin drains through a number of structures into Butte Creek but by written agreements between the duck clubs, upper reclamation and drainage districts and the Western Canal Company, the spill through these structures is so regulated that a permanent lake is maintained in the basin. It appeared possible to drain this lake through one of the lower structures and it was estimated in August, 1926, that this would furnish a flow to the River of from 150 to 200 second-feet for fifteen days or more. As the drainage from some 30,000 acres of rice would pass down through the basin in September, it appearad that the gun clubs would have ample opportunity to get the lake filled again before the shooting season should commence. To effect this drainage measure it was necessary that the consent of all of the various parties to the above mentioned agreements be obtained. The consent of nearly all of these was secured but unfortunately a satisfactory agreement between the Western Canal Company and the duck clubs could not be reached and the lower gate was not opened to drain the basin. Fortunately the critical situation on the river was passed successfully without the additional aid which would have been given by this drainage measure. Although the lower gate was not operated to drain the basin, it should be noted that all other structures along Butte Creek were kept open to permit the flow of drainage to the Sacramento River via Butte Creek, and on the whole, the attitude of the Butte Basin clubs and cooperation extended by them in this effort are to be commended.

Knights Landing North Water Users Association.

A promising forward step, resultant from the 1926 shortage for irrigation, was that taken by districts and water companies on the Sacramento River in organizing the "Knights Landing North Water Users Association." This association, not yet completely organized, proposes, as the name implies, to include all Sacramento River water users north of Knights Landing. As stated in its constitution the purpose is to form an organization "—to the end that the low water flow of the river may be so used and conserved as to avoid friction and litigation among diverters * * * and to work with the United States War Department in charge of Navigation on the Sacramento River, the State Division of Water Rights, and the Permanent Committee of the Sacramento-San Joaquin River Problems Conference in all questions of policy regarding the use of water from the river." This organization should greatly facilitate conservation work and all dealings with these water users.



BARGES OF GRAIN FROM UP RIVER POINTS AT CITY OF SACRAMENTO WHARVES.

PLATE 24.

Engineering Investigation—Measurements and Collection of Records.

The measurements, collection of records and engineering investigations specified as a part of the work of the Water Supervisor, have been continued in the past biennium in much the same manner as during 1924. The work for the latter year has been reported in the preceding biennial report and in Bulletin No. 4. Briefly, this work comprises measurements and records of all diversions of water from the Sacramento, Feather, Yuba, American and lower San Joaquin rivers within the valley floor and above the delta; stream flow measurements throughout the territory, partially in cooperation with the Water Resources Branch, U. S. Geological Survey; measurement and record of waters returned both to the Sacramento and San Joaquin rivers; intensive studies of the duty of water on peat and sedimentary lands in the delta region in cooperation with the U. S. Department of Agriculture, Division of Agricultural Engineering and the University of California Agricultural Experiment Station; an annual census of irrigated areas and crops under all diversions recorded and throughout the delta; and investigation and study of the advance and retreat of salinity in the delta channels.

Divisions of Work and Organization.

This work is naturally divided as follows: (1) stream flow measurements, (2) diversion measurements and records, (3) return water measurements, (4) duty of water studies and use of water in the Sacramento-San Joaquin Delta, and (5) salinity investigations.

In the conduct of the work the organization has included in addition to the Water Supervisor, two assistant hydraulic engineers working on the Sacramento River and one assistant hydraulic engineer covering the Feather and American rivers, the delta uplands and the irrigation census in the delta. In addition, the organization for the cooperative delta duty of water investigations under the direction of W. W. McLaughlin, associate chief, Division of Agricultural Engineering, U. S. Department of Agriculture, has included an hydraulic engineer and two assistants giving full time to the field work.

Stream Flow Measurements.

During the irrigation seasons of 1925 and 1926, stream flow measurements and records have been obtained through cooperation with the U. S. Geological Survey on the Sacramento River at Red Bluff, Butte City, Colusa and Knights Landing; on the Feather River at Nicolaus; on the American River at Fair Oaks, on the Mokelumne River at Woodbridge, and on the San Joaquin River near Vernalis. Supplementing these, the Water Supervisor has maintained additional stations on upper Butte Creek one mile west of the East Side Highway, on lower Butte Creek and Butte Slough, at Verona on the Sacramento River and at H street bridge on the American River.

The station at Verona located a short distance below the junction of the Feather with the Sacramento River, has proven to be a very satisfactory one for use in estimating the flow past Sacramento. Because of tidal action at Sacramento, it is not practical to obtain a continuous record of the flow at a station immediately adjacent to the city and previously the discharge here has been estimated by using the Knights Landing record and making allowance for the inflow and draft between Knights Landing and Sacramento. The Verona station has furnished a better record than that at Knights Landing and in arriving at the flow past Sacramento from this record, the allowances to be made for inflow and draft below the station are much simpler. On Plate 27, hydrographs are shown for the discharge of the Sacramento River near Red Bluff and at Sacramento for the 1924, 1925 and 1926 irrigation seasons. The annual reports of the Water Supervisor present in full the stream flow data for all stations above mentioned.

Diversion Measurements and Records.

Records and measurements of diversions for 1925 and 1926 have included those from the Sacramento River and its tributaries within the valley floor and those to the delta uplands from San Joaquin River, Old San Joaquin River and Tom Paine Slough. In extension of the

PICTURESQUE SACRAMENTO RIVER DIVERSION FOURTEEN MILES ABOVE SACRAMENTO.

Elkhorn Plant of the Natomas Company. Average capacity, 70 second-feet. All river diversions are measured and recorded by the Sacramento-San Joaquin Water Supervisor.

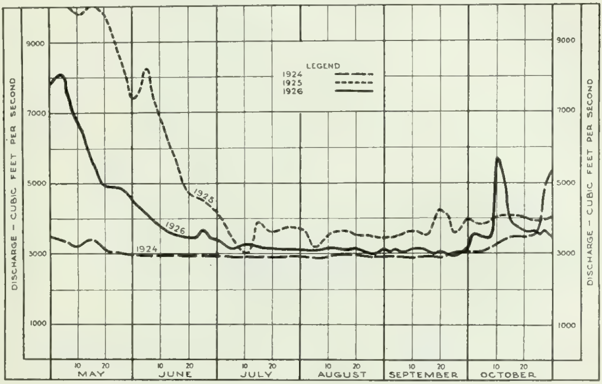
PLATE 25.

work of 1924 there were obtained in 1925 diversion records for the Feather River from Marysville to Oroville, for the lower Yuba River, for Colusa Trough and the Back Borrow Pit of reclamation districts 108 and 787, for Tisdale and Sutter By-passes and for the American River from H street bridge to Fair Oaks. The 1926 records included all diversions of previous years and a number of new ones. The 1925 records were for a total of 316 diversions, segregated to the various sources as follows: Sacramento River 194, lower Butte Creek and Butte Slough 9, Colusa Trough 6, Back Borrow Pit (carrying drainage water from Colusa Basin along the back levees of reclamation districts 108 and 787) 4, Tisdale and Sutter by-passes 7, Feather River 31, lower Yuba River 5, American River 28, Old San Joaquin River to Delta Uplands 4, Tom Paine Slough to Uplands 7, and San Joaquin River to Uplands (below the junction with Stanislaus River) 21.

LOADING CELERY FROM ISLAND LEVEE, SAN JOAQUIN RIVER DELTA.

PLATE 26.

COMPARATIVE DISCHARGE OF SACRAMENTO RIVER AT RED BLUFF



AT SACRAMENTO

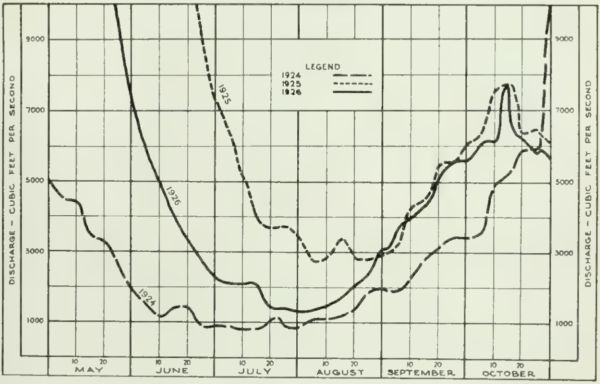


PLATE 27.

TABLE 7.

Sacramento-San Joaquin Diversions and Acreages Irrigated, 1924 and 1925.

Stream	Diversions, April to October, inclusive, acre-feet		Acreage irrigated			
			1924		1925	
	1924	1925	General	Rice	General	Rice
Sacramento River—Redding to Sacramento	945,449	842,263	104,269	59,688	76,222	58,025
Feather River, Oroville to mouth	[1]352,694	413,020	[1]22,402	[1]22,541	25,560	26,734
Lower Yuba River		4,045			1,796	
Colusa Trough and Back Borrow Pit	[2]38,205	[2]29,776	[3]1,820	[3]5,766		[4]9,940
Butte Slough and Lower Butte Creek	2,984	2,512	959		904	
American River, Fairoaks to mouth	[5]750	4,343	[5]240		3,510	
Old San Joaquin River, Delta Uplands	70,560	64,277	29,190		34,677	
Tom Paine Slough, Delta Uplands	14,524	14,386	2,810		7,441	
San Joaquin River, Delta Uplands	10,360	5,734	4,335		3,224	
Totals	1,435,526	1,380,356	166,025	87,995	153,334	94,699

[1] Figures for 1924 are for diversions from mouth of river to Marysville only with the exception that Sutter Butte Canal Company and Western Canal Company diversions and acreages have been included.

[2] Includes some gun club diversions.

[3] These acreages, except for 300 acres rice irrigated from Back Borrow Pit, were watered from both the Trough and Sacramento River.

[4] Of this area, 4,000 acres were irrigated from both the Trough and Sacramento River.

[5] H Street Bridge to mouth of river, only.

TABLE 8.

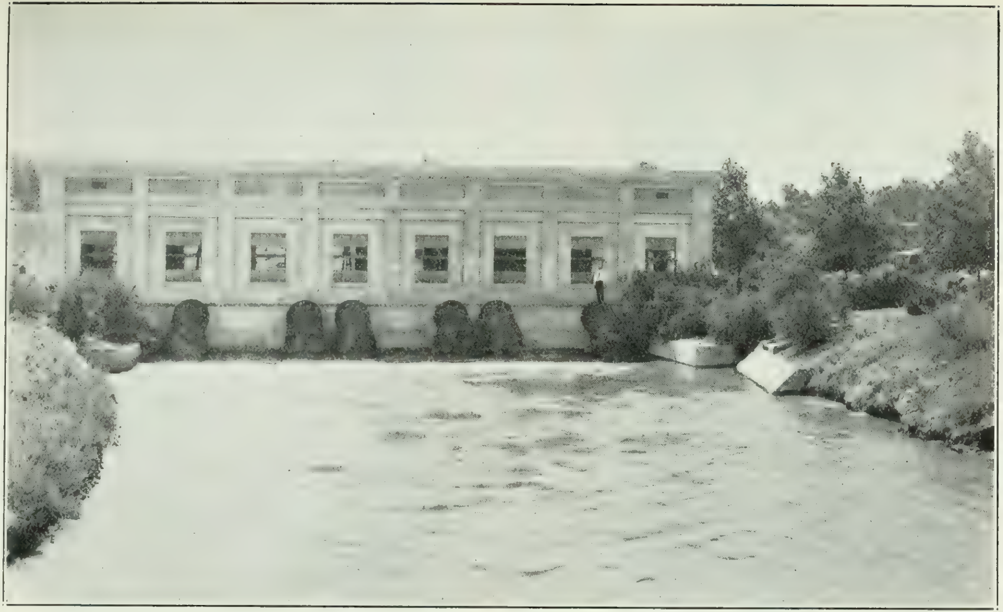
Summary of Sacramento River Diversions, 1925, Acre-feet.

River section	April	May	June	July	August	September	October	Totals
Redding to Red Bluff	884	13,333	19,219	23,338	23,330	20,795	4,544	105,443
Red Bluff to Butte City	1,370	29,040	80,671	96,153	92,662	63,346	5,802	369,044
Butte City to Colusa	0	8,646	15,307	20,949	13,859	9,663	988	69,412
Colusa to Knights Landing	3,834	28,519	51,926	50,046	46,015	29,691	3,440	213,471
Knights Landing to Sacramento	5,089	8,171	17,028	21,302	19,022	10,947	3,334	84,893
Totals	11,177	87,709	184,151	211,788	194,888	134,442	18,108	842,263

During the last two seasons much better cooperation has been given by the water users in keeping the daily operation records of their pumping. This has made it possible to compile from the monthly diversion records as computed from the power data, a daily diversion record for practically every plant.

In 1925 the month of maximum irrigation draft on the Sacramento River was July in which month the draft averaged slightly more than 3000 second-feet for the stretch of river between Red Bluff and Sacramento. Due principally to a considerably larger rice acreage in 1926 than in the two previous years, the maximum draft for the same stretch of river in 1926 was close to 4000 second-feet. It is interesting to note that with a draft of about 3950 second-feet on August 1st between Red Bluff and Sacramento, there was only a flow of 3150 second-feet in the river at Red Bluff. At the same time there was a flow of 1290 second-feet past Sacramento thus indicating an inflow to the river of 2090 second-feet from return water and tributaries. Of this inflow only 510 second-feet was entering from the Feather and American rivers.

The total measured diversions in acre-feet for the 1924 and 1925 seasons for the months April to October, inclusive, are shown segre-



ONE OF THE LARGEST IRRIGATION PUMPING PLANTS ON THE UPPER SACRAMENTO RIVER.

Tisdale plant of the Sutter Basin Company near Grimes. Average capacity 600 second-feet. Records of the Water Supervisor show a diversion of 136,000 acre-feet at this plant in 1925.

PLATE 28.

gated to the various streams in Table 7. This gives also the acreages irrigated. Table 8 presents the 1925 diversions in acre-feet for the months April to October, inclusive, for the Sacramento River by sections from Redding to Sacramento. The computations for the 1926 diversions could not be completed in time to be available in this report.

Return Water Measurements.

This important work comprising the measurements and records of all return water tributary to the Sacramento and San Joaquin Rivers has been continued during the past biennium. As in 1924 this has covered in the Sacramento Valley the return water entering the river through Butte Slough, District 70 Drain, District 108 Drain, the Back Borrow Pit of reclamation districts 108 and 787 (Colusa Basin Drainage), Sacramento Slough and through various pumping plants operated for drainage during the irrigation season.

In the San Joaquin Valley the plan of three series of measurements each season at numerous points on the San Joaquin River and its tributaries has been followed as heretofore.

A description of the return water investigation and results for the biennium is presented in full in Appendix B of this report.

Delta Investigations—Cooperative Work.

The measurements and investigations in the Sacramento-San Joaquin Delta during the past biennium have followed along similar lines to those of 1924 with some extensions. This work is segregated into that carried on through the regular organization of the Water Supervisor and that conducted under a cooperative agreement between state and federal offices as outlined in Appendix C. The work under the first-named segregation has comprised the collection of data as to acreages and crops irrigated, period of irrigation, general soil classifications of irrigated areas, etc., throughout the delta. That of the last-named segregation has comprised the special duty of water investigations on Medford and King islands and on Reclamation District No. 999.

TABLE 9.

Summary of Acreages and Crops Irrigated in the Sacramento-San Joaquin Delta—1925 and 1926.

	Acres	
Crop	*1925*	*1926*
Alfalfa	26,011	25,128
Asparagus	51,974	55,601
Beans	37,590	51,344
Beets	16,685	7,936
Celery	5,330	7,392
Corn	24,029	23,955
Fruit	12,772	17,771
Grain	7,399	31,625
Hay	3,767	1,337
Onions	5,989	5,810
Pasture	5,273	4,161
Potatoes	22,071	21,503
Seed	3,459	2,883
Truck and miscellaneous vegetables	4,737	5,349
Totals	227,086	261,795

When the determinations of the duty of water for the delta lands have been completed they may be used in conjunction with the information as to total acreages and crops irrigated, etc., to estimate the total

CELERY ON THE PEAT LANDS OF THE SACRAMENTO-SAN JOAQUIN DELTA.

Note the black peat soil. To insure white celery the soil has been banked around the plants leaving the tops only exposed. With this crop the harvest begins in November and irrigation must extend well into the fall. Records of the Water Supervisor show over 5000 acres irrigated in 1925. This is reported to comprise over thirty per cent of the celery grown in the United States.

PLATE 29.

ONION SEED CROP, RECLAMATION DISTRICT 999, SACRAMENTO RIVER DELTA.

PLATE 30.

consumptive use of water by the delta lands which is the major fact sought in this work.

The results to date from the detailed duty investigations conducted on the delta islands have been most interesting and enlightening but can not yet be considered conclusive. Experiments on various crops grown in tanks have definitely indicated the total water requirements under delta conditions but comparison of the results of these experiments with measurements of net amounts of water supplied to the islands or individual tracts on those islands obviously indicates a supply of water to the crops other than from the surface diversions, siphons, pumps, gravity inlets, etc. Presumably the additional supply is to be attributed to seepage. It would seem evident that a proper administration of the waters in the future will require a knowledge not only of the total water requirements of the various crops as determined by tank experiments but of the amounts of water needed both gross and net apart from that supplied by seepage. And in the development of this knowledge lie the chief problems and need for the continuation of these duty of water investigations.

A detailed report of the Delta Cooperative Investigations for the biennium prepared by O. V. P. Stout, irrrigation engineer of the Division of Agricultural Engineering, U. S. Department of Agriculture, who has been in charge of this work, has been submitted by W. W. McLaughlin, associate chief of the Division of Agricultural Engineering. This is presented in full as Appendix C.

A summary of the data pertaining to acreages and crops irrigated in the delta during the 1925 and 1926 seasons is given in Table 9. These data were obtained in a similar manner to that followed in 1924. In the annual reports of the Water Supervisor, detailed information is given as to the irrigated acreages and crops for each island or tract in the delta. As above stated, this information is that which is complementary to the duty of water investigations in determining the delta's total use of water.

Salinity Investigations.

The salinity investigations have been continued during the biennium with little change over the methods of past years. With an irrigated area in the delta somewhat less in 1925 than in 1924 and a stream flow more nearly approaching normal, there occurred in 1925 no serious encroachment of salt water into the delta channels. In that year the salinity tests were commenced at the lower stations on May 1st and only sixteen stations were maintained in following the encroachment.

In 1926 with a considerably increased irrigation draft in the Sacramento Valley and a stream flow much below normal, the salinity assumed proportions approaching the conditions of 1924 and the investigations in this connection required considerable attention upon the part of the Water Supervisor's office. By the end of August, samples were being taken and forwarded for testing from thirty-nine stations throughout the delta. As in 1924, weekly salinity bulletins were mailed to interested irrigationists to so keep them advised as to the salinity encroachment that use of water detrimental to their crops might be avoided. The salinity investigations for the biennium are presented in detail in Appendix A of this report.

Value of Work to Date.

Since the initiation of the Water Supervisor plan in the Sacramento-San Joaquin territory in the spring of 1924, the work for three seasons has been completed. In this period ample opportunity has been given to view the need for and benefits to be derived from this work and it is believed that its value has been thoroughly demonstrated. Of paramount consideration is the fact that in the collection of the three years' records of the use of water and other fundamental physical facts and data, a necessary and important step has been taken leading to the ultimate adjudication, mutual agreement or other adjustment which will be consummated as a basis for water distribution.

The procedure to date has been to make the best of the situation through conservation. This includes water supervision or water master service which is essentially a conservation feature. Until such time as additional water supplies are made available through storage or otherwise this will undoubtedly continue to be the best and only reasonable procedure.

CHAPTER X.

FINANCIAL STATEMENT.

The following statement, which is submitted as Table 10, shows the income and expenditures of the Division of Water Rights during the period July 1, 1924, to June 30, 1926. It is segregated by funds, appropriative and contributive, the latter being entirely supplied by outside interests. Only actual expenditures up to June 30, 1926, are included, no allowance being made for incumbrances as of that date paid subsequent thereto.

TABLE 10.

Financial Statement Showing Income and Expenditures of the Division of Water Rights for the 76th and 77th Fiscal Years.

Appropriative and contributive funds	*Balance June 30, 1924*	*Additional appropriations*	*Actual expenditures*	*Balance June 30, 1926*
Appropriations:				
Chapter 411–21, survey water resources	$8,580 70	----------	$8,580 00	$0 70
Chapter 121–23, salaries seventy-fifth fiscal year	6,963 94	----------	6,963 94	---------
Chapter 121–23, support seventy-fifth fiscal year	1,531 19	----------	1,531 19	---------
Chapter 121–23, salaries seventy-sixth fiscal year	--------	$48,440 00	48,406 05	33 95
Chapter 121–23, support seventy-sixth fiscal year	--------	17,950 00	17,936 58	13 42
Chapter 309–23, gaging streams	10,692 05	----------	10,691 85	20
Chapter 30–25, salaries seventy-seventh fiscal year	--------	64,000 00	62,054 84	1,945 16
Chapter 30–25, support seventy-seventh fiscal year	--------	20,587 50	15,539 27	5,048 23
Chapter 30–25, investigation streams and lakes	--------	50,000 00	20,357 82	29,642 18
Chapter 190–25, gaging streams	--------	20,000 00	7,014 45	12,985 55
Totals	$27,767 88	$220,977 50	$199,075 99	$49,669 39
Chapter 854–21, treasury revolving fund	$12,450 57	$12,061 88	$16,239 40	$8,273 05
Contributive Funds:				
Hat Creek Water Master's Fund	$167 74	$1,285 55	$1,449 37	$3 92
Sacramento-San Joaquin Water Supervisor Fund	2,238 17	11,300 00	13,537 79	38
San Dimas Fund	618 28	1,600 00	2,171 73	46 55
San Gabriel River Fund	5,598 15	32,000 00	36,567 05	1,031 10
Burney Creek Water Master's Fund	--------	976 85	952 96	23 89
Cottonwood Creek Water Master's Fund	--------	99 00	99 00	---------
North Cow Creek Water Master's Fund	--------	531 20	235 30	295 90
Oak Run Creek Water Master's Fund	--------	131 46	60 15	71 31
Shasta River Water Master's Fund	--------	1,084 49	1,064 79	19 70
Surprise Valley Water Master's Fund	--------	976 30	914 90	61 40
Totals	$8,622 34	$49,984 85*	$57,053 04	$1,554 15
Grand Totals	$48,840 86	$283,024 23	$272,368 43	$59,496 66
Fees collected and credited to General State Fund				$58,759 76

* Contributions.

Fees.

In the period above mentioned, fees in the amount of $58,759.76 were collected and transmitted to the State Controller for deposit in the state treasury to the credit of the general fund of the state, as prescribed by law. These fees include those received for filing applications, those received in connection with the issuance of permits, and those received in connection with miscellaneous charges, such as for copying and certifying records. The main portion, however, is made up of application and permit fees, which are collected on a sliding scale basis as set forth in the Water Commission Act. The amount thus received in fees during each of the last nine years is as follows:

1917–1918	$4,157 73
1918–1919	3,999 55
1919–1920	6,769 76
1920–1921	16,660 70
1921–1922	17,362 09
1922–1923	18,311 81
1923–1924	16,150 91
1924–1925	33,287 97
1925–1926	25,471 79

PLATE 31A.

TYPICAL SOURCE OF CALIFORNIA WATER SUPPLY.

Snow fields in the higher mountains.

APPENDIX A.

SALINITY.

When low flow conditions prevail in the Sacramento and San Joaquin rivers during the irrigation season a condition is reached where the supply of fresh water to the many channels in the large delta area between Sacramento on the north, Stockton on the east, Tracy on the south and Antioch on the west, is insufficient to prevent the encroachment into these channels of salt water from San Francisco Bay. The salt encroachment in large or small proportions has become a familiar condition to those in the Sacramento-San Joaquin delta areas and salinity investigations have been conducted more or less extensively since 1916. The investigations by the State Water Commission, predecessor to the Division of Water Rights and those by the Division up to and including the 1924 season, have been reported in detail in previous biennial reports and in the Water Supervisor's Report for 1924 published in Bulletin No. 4 of the Division. Since and including 1924 the investigations have been conducted through the office of the Sacramento-San Joaquin Water Supervisor under the direction of the Division.

Purpose of Investigations.

As outlined in previous reports, the chief purpose of the investigations to date has been to determine as closely as possible the relation which may exist between the discharge of fresh water to the delta through the rivers and the advance and retreat of the salinity. In seasons of low river flow, the investigations have had the additional important purpose of supplying the delta irrigationists at frequent intervals with information as to the extent of the salinity in the water adjacent to their intakes. In carrying out the latter, the Water Supervisor's office has, during the 1926 season, mailed weekly bulletins to more than one hundred water users throughout the delta.

Salinity Stations and Procedure.

The encroachment of salinity into the delta channels in 1925 was very much less than that in 1924. In the latter year, thirty-two stations were required to follow the encroachment. In 1925 tests were commenced at the O. and A. ferry, Collinsville and Antioch on May 1st and the sixteenth and last station was started at Cache Slough on August 20th. In the fall of 1925 the recession of the salinity occurred very gradually until the high water early in February, 1926. Stations maintained in 1925 were only discontinued when the tests showed a chlorine content down to about ten parts per 100 000. The stations at the O. and A. ferry, Collinsville and Antioch and four new ones established on San Pablo and Suisun bays have been maintained continuously. The new stations established on the bays early in February, 1926, are Point Orient, Point Davis, Bullhead Point and Bay Point. These stations were established to furnish information as to the relation between the inflow from the rivers and the salinity in the bays particu-

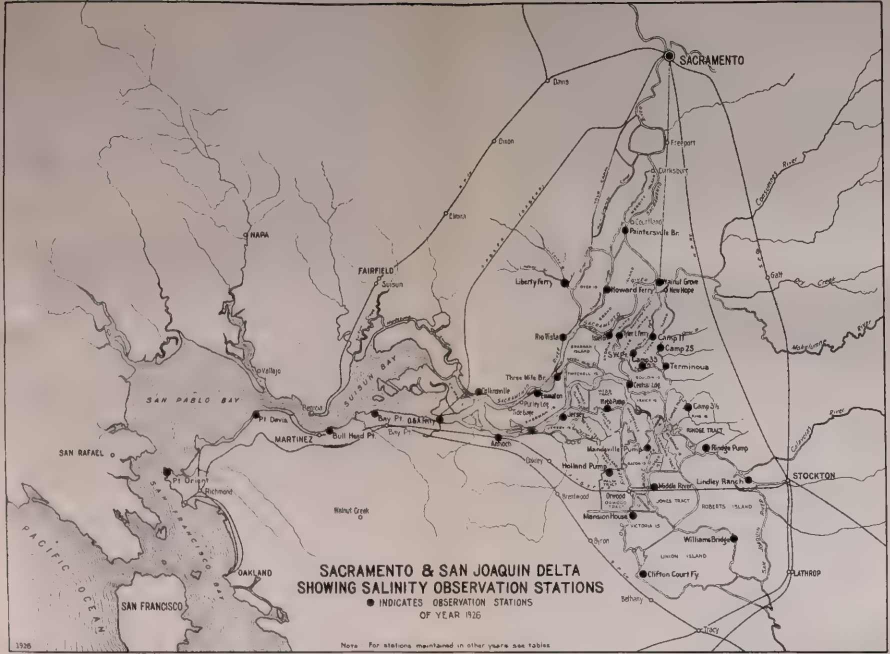


PLATE 31.

TABLE 11.

SALINITY OBSERVATION STATIONS MAINTAINED BY SACRAMENTO-SAN JOAQUIN WATER SUPERVISOR, DIVISION OF WATER RIGHTS, 1925 AND 1926.

Stations (Arranged in upstream order)	Description	Period of tests	
		1925	1926
	Upper Bay and Sacramento River Delta.		
Point Orient	Upper end San Francisco Bay, east shore, one-half mile south of Point San Pablo—wharf of Standard Oil Company		Feb. 10– **
Point Davis	Upper end San Pablo Bay, south shore—Oleum wharf of Union Oil Company		Feb. 6– **
Bull Head Point	Lower end Suisun Bay, south shore—wharf of Mountain Copper Company		Feb. 2– **
Bay Point	Center Suisun Bay, south shore—Bay Point wharf of Coos Bay Lumber Company		Feb. 2– **
O and A Ferry	Upper end Suisun Bay between Mallard Station and Chipps Island	May 12, 1925 con	tinuously to date
Collinsville	North bank Sacramento River at junction with San Joaquin River	May 10, 1925, con	tinuously to date
Emmaton	South bank Sacramento River just above Baker Point Cut, on Horseshoe Bend	July 10–Nov. 28	June 16– *
Three Mile Slough Bridge	Just above junction of Slough and Sacramento River—previous to 1926 station was at Three Mile Slough Ferry just below junction of Three and Seven Mile Sloughs	July 24–Dec. 26	June 10– *
Rio Vista Bridge	Right bank Sacramento River 2 miles below junction of Cache and Steamboat Sloughs	July 28–Oct. 24	June 8– *
Isleton Bridge	Left bank Sacramento River 3 miles above junction with Steamboat Slough	Aug. 4–Nov. 6	June 30–Oct. 18
Liberty Ferry (Cache Slough)	Cache Slough at junction with Lindsay Slough—in 1925 samples were taken at Liberty Farms Company headquarters on Cache Slough, about 1½ miles upstream from Ferry	Aug. 22–Dec. 6	July 10– *
Howard Ferry (Steamboat Slough)	Steamboat Slough, 1½ miles below junction with Sutter Slough		July 22–Oct. 22
Walnut Grove	Left bank Sacramento River at upper end of Georgiana Slough		Aug. 18– *
Paintersville Bridge	Sacramento River—1 mile below Courtland, new bridge 1926		Aug. 18– *
	Mokelumne River Delta.		
Southwest Point (Staten Island)	Staten Island, south bank, North Fork Mokelumne River just above junction with South Fork		July 14– *
Camp 7 (Staten Island)	Staten Island, south bank, North Fork Mokelumne River approximately 3 miles above South Fork junction		†July 30– *
Camp 33 (Staten Island)	Staten Island, north bank, South Fork Mokelumne River, 2 miles above junction North Fork		July 14– *
Tyler Island Ferry	On Georgiana Slough—1½ miles east of Isleton		July 22–Oct. 22
Camp 11 (Staten Island)	Staten Island, left bank, North Fork Mokelumne River—4 miles above junction South Fork		July 14– *
Terminus (Camp 29, Staten Island)	Staten Island, north bank, South Fork Mokelumne River opposite Terminus		July 14– *
Eagle Tree (Staten Island)	Staten Island, south bank, North Fork Mokelumne River—1¾ miles below County Road Bridge		†July 30– *
Camp 25 (Staten Island)	Staten Island, west bank, South Fork Mokelumne River—1 mile above junction Sycamore Slough		July 14– *
New Hope Bridge (Staten Island)	North end Staten Island at dividing point North and South Forks Mokelumne River		†July 30– *
Camp 20 (Staten Island)	Staten Island, west bank, South Fork Mokelumne River—one-half mile below junction Beaver Slough		†July 30– *
	San Joaquin River Delta.		
Antioch	Left bank San Joaquin River 3½ miles above junction with Sacramento River	May 2, 1925, con	tinuously to date
Jersey	Left bank San Joaquin River 1 mile below mouth of False River	July 10-Jan. 22, '26	June 10– *
Webb Pump	Washington Slough—2 miles below junction with Old River	July 20-Jan. 22, '26	June 10– *
Holland Pump	North bank Rock Slough—1½ miles west of junction with Old River	Aug. 6-Jan. 10, '26	July 2– *
Central Landing (Bouldin Island)	Bouldin Island, left bank, Mokelumne River—one-half mile above junction San Joaquin River	Aug. 6–Nov. 14	July 10– *
Palm Tract	West bank, Old San Joaquin River near Palm Tract pump, just north of Santa Fe Railroad crossing		Aug. 6– *
Middle River	East bank Middle River at A. T. and S. F. Railroad crossing	Aug. 12–Nov. 30	June 30– *
Mandeville Pump	South end Mandeville Island, north bank Connection Slough—1 mile west Middle River		July 10– *
Medford Pump	Medford Island on channel connecting Whiskey Slough and Middle River	Aug. 4–Nov. 6	
Mansion House	Victoria Island, east bank, Old River at junction with North Victoria Canal	Aug. 12-Feb. 8, '26	July 22– *
King Island (Camp 3½)	King Island at junction of White Slough and Honkers Cut		Sept. 22– *
Rindge Pump	North Bank San Joaquin River 1 mile below junction Fourteen Mile Slough	Aug. 12-Feb. 6, '26	July 26– *
Clifton Court Ferry	Old River at junction with Grant Line Canal		Aug. 18–Oct. 10
Stockton Country Club	North bank Lindley Cut (San Joaquin River) at lower end of Cut—samples in first part of 1926 season taken at Lindley Ranch headquarters on opposite bank of Cut		Aug. 18– *
Williams Bridge	Middle River—about 4 miles below junction with Old River		Aug. 18 *

*Observation season not yet closed at date of this report.

**Station established February, 1926, and to be maintained continuously throughout each year.

†Samples only on 10th, 22d and 30th of month.

larly at such times as the river flow becomes sufficient to make, or insufficient to keep, the bay waters fresh or low in salinity. The observations at these stations will be more or less a continuation of those initiated by Engineer Walker R. Young of the United States Bureau of Reclamation in connection with his investigation in 1924 and 1925 for the salt water restraining dam.

During 1926 all local observers were directed to take samples on the 2d, 6th, 10th, 14th, 18th, 22d, 26th and 30th days of each month and at approximately one and one-half hours after high tide (the approximate time of maximum salinity with respect to the tide). This insured greater uniformity in the sampling and made it possible to check up on apparent inconsistencies, to make proper comparison of results as between the various stations and to detect any errors on the part of the observers. Tests were received from thirty-nine stations during this season.

1926 Conditions.

Although the total flow of the rivers to the delta in 1926 was considerably less than that in 1925 and approached the low flow of 1924, there was a much greater Spring flow than in 1924. This served the purpose of keeping the delta channels and upper bays flushed with fresh water so that as late as May 1st the salinity at Bay Point was only about ten parts of chlorine per 100 000. With a rapid decrease in the stream flow in June, however, the salinity commenced its advance and it had proceeded well into the delta channels when the minimum flow in the rivers was reached at the last of July. In August the flow of the Sacramento River at Sacramento commenced to increase due to the increased return flow and the beginning of diversion reductions, and with a continued increase from this source the records show that a recession in salinity began at Isleton about August 20th and at Rio Vista, Emmaton and Jersey about the end of August or first of September. At San Joaquin Delta stations remote from the influence of the increased Sacramento flow there was little if any drop in the salinity up to October 1st.

Comparison of Salinity 1920–1924–1926.

Within the short space of the last six years, there have been three seasons of low river flow and consequent salinity encroachment of some magnitude. These were the seasons of 1920, 1924 and 1926. In Table 12 a comparison is given of the maximum salinities occurring at the various stations for these three seasons.

Salinity—River Discharge Relation.

In arranging the data obtained to indicate such relation as may exist between the advance and retreat of the salinity and the river flow, previous reports have carried a chart for each year showing curves of the rise and fall, during the season, of the salinity at various stations and, superimposed on these curves, hydrographs of the Sacramento River at Sacramento and the San Joaquin River near Vernalis. In continuation of this arrangement, Plate 32 of this report presents the 1924, 1925 and 1926 graphs. With accurate records of the discharge of the Sacramento River past Sacramento available for the 1924, 1925 and 1926 irrigation seasons it is now possible to make a fair deduction as to the quantities of water required for salinity control at various delta points. However, such deductions based upon the information available to date can in no way be considered conclusive. This investigation should of course consider in addition to the flow of the rivers to the Delta, the irrigation draft in the Delta area, and although the latter has probably not changed materially within the last three years, still it is as yet more or less an unknown factor and one which it will be necessary to evaluate. The results indicate a considerable variation between the quantity of water required to prevent salinity encroachment at any particular station and that required to turn it back once it is established. Again the water requirement for preventing the encroachment at any particular station may vary considerably between two seasons. The variation in the Delta irrigation draft might account for the latter. There is also to be taken into account, the greater or lesser extent to which Upper San Francisco Bay, San Pablo and Suisun Bays have been freshened by the spring run-off of the rivers. Although the stream flow may be low during the summer, if the low flow has been preceded by a heavy late spring flow, the bay will have been freshened and the extent of the salinity encroachment before relief comes in the fall, materially reduced. In view of the wide limits within which the investigations to date would still leave the determination of the salinity-discharge relation and recognizing the necessity for evaluating additional factors which may explain some of the variable results and inconsistencies it seems apparent that the investigations must be extended over a longer period.

TABLE 12.

Comparison of Maximum Salinity, 1920–1924–1926 Sacramento-San Joaquin Delta.

Parts of Chlorine per 100,000.

	1920		*1924*		*1926*	
Station	*Amt.*	*Date*	*Amt.*	*Date*	*Amt.*	*Date*
O and A Ferry	981	Sept. 22	1,345	Aug. 28	1,100	Aug. 26
Collinsville	890	Aug. 19	1,150	Aug. 16	1,020	Sept. 6
Emmaton	474	Sept. 12	802	Aug. 6	540	Aug. 22
Three Mile Slough[1]	415	Sept. 14	692	Aug. 30	430	Aug. 26
Rio Vista	235	Sept. 9	608	Aug. 12	256	Aug. 30
Isleton	36	Aug. 18	310	Aug. 14	68	Aug. 19
Cache Slough[2]	35	Sept. 15	192	Aug. 16	33	Aug. 26
Steamboat Slough[3]	14	Sept. 16	100	Aug. 4	27	Aug. 6
Walnut Grove	18	Sept. 16	42	Aug. 10	15	Aug. 19
Antioch	762	Sept. 3	1,080	Aug. 20	920	Aug. 26
Jersey	346	Sept. 14	708	Aug. 30	470	Aug. 26
Webb Pump	168	Sept. 7	414	Sept. 6	147	Aug. 14
Holland Pump	---	-------	308	Oct. 4	148	Sept. 2
Central Landing (Bouldin Is.)	80	Sept. 15	288	Sept. 24	98	Sept. 2
Orwood[4]	38	Oct. 5	----	--------	86	Sept. 18
Middle River (P. O.)	---	-- ----	186	Sept. 30	69	Oct. 8
Mansion House (Victoria Is.)	---	-- ----	148	Oct. 12	69	Sept. 26
S. W. Point (Staten Is.)	57	Sept. 10	----	--------	65	Aug. 26
Camp 33 (Staten Is.)	---	-- ----	113	Aug. 30	32	Sept. 6
Tyler Island Ferry	18	Sept. 25	44	Aug. 8	19	Aug. 2
Camp 11 (Staten Is.)	---	-- ----	96	Sept. 26	23	Sept. 6
Terminus	28	Sept. 18	----	--------	25	Sept. 2
Camp 25 (Staten Is.)	---	-- ----	110	Sept. 24	24	Sept. 14
Rindge Pump	---	-- ----	126	Sept. 16	50	Sept. 14
Clifton Court Ferry	---	-- ----	80	Oct. 2	32	Sept. 6
Wakefield Landing[5]	---	-- ----	108	Sept. 16	48	Aug. 30
Williams Bridge (Middle River)	---	-- ----	42	Sept. 4	18	Sept. 2

[1] Ferry in 1920 and 1924, Bridge in 1926.
[2] Jones Landing, 1920, Liberty Ferry, 1924 and 1926.
[3] Walker Landing, 1920, Howard Ferry, 1924 and 1926.
[4] Listed as Palm Tract Pump in 1926.
[5] Samples taken at Lindley Ranch Headquarters and Stockton Country Club in 1926.

RELATION OF SALINITY IN THE SACRAMENTO~SAN JOAQUIN DELTA TO RIVER DISCHARGE

SALINITY CURVES INDICATE MAXIMUM SALINITY DURING DAYLIGHT HOURS

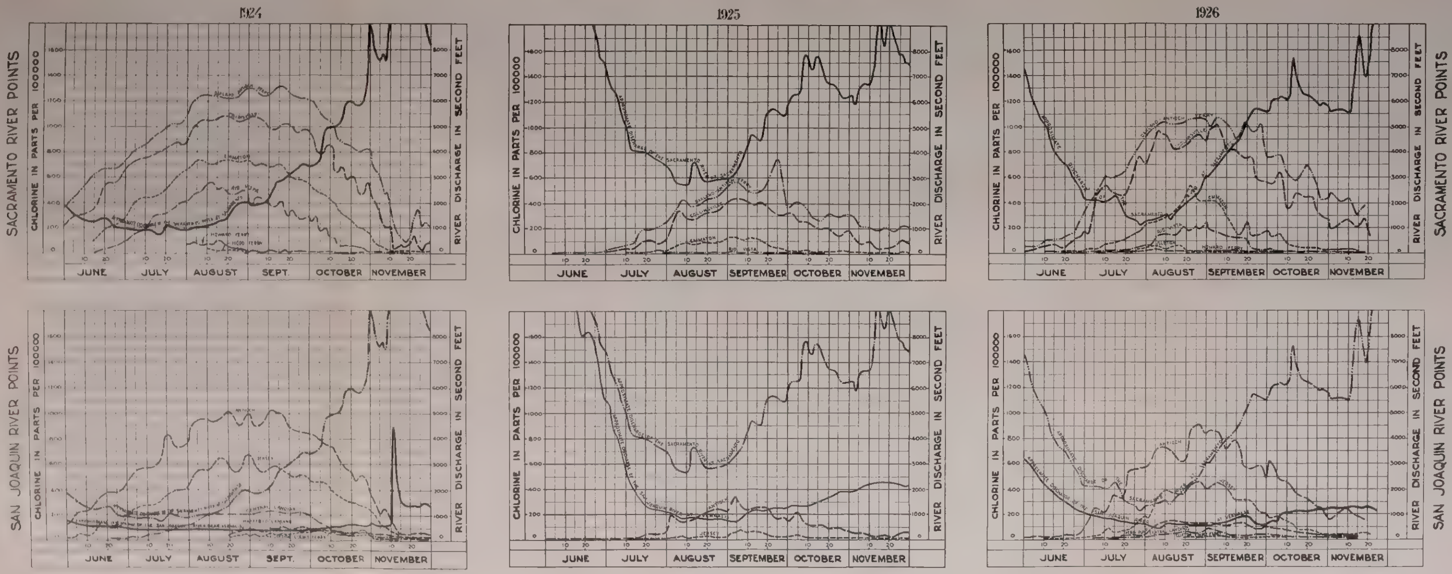


PLATE 32

In studying the salinity-stream flow relation, it is interesting to make a comparison between maximum salinity at some of the delta stations and the total annual run-off of the streams tributary to San Francisco Bay. In Bulletin No. 5 of the State Division of Engineering and Irrigation entitled "Flow in California Streams," the run-off for the various streams entering the valley is tabulated and that for each year is shown as a per cent of the long time mean. Utilizing these tabulations for the period 1918-19 to 1920-21 and extending the tables to include the water year 1925-26 (October 1, 1925 to September 30, 1926) the combined run-off to the valley for all the streams expressed as a percentage of the normal run-off is derived. These run-off percentages are shown in Table 13, column 2. In further explanation, the figure 70 per cent, for example, for the year 1922-23, as shown in Table 13, indicates that the flow to the valley of all of the streams as measured at the foothill stations for the entire water year 1922-23 amounted to 70 per cent of the mean combined flow for a long period. The streams and stations used in this computation are the following: Sacramento River near Red Bluff, Feather River at Oroville, Yuba River at Smartsville, Bear River at Van Trent, American River at Fair Oaks, Cosumnes River at Michigan Bar, Mokelumne River at Clement, Calaveras River at Jenny Lind, Stanislaus River at Knights Ferry, Tuolumne River at La Grange (and Jacksonville), Merced River at Merced Falls (and Exchequer), and San Joaquin River at Friant. Opposite the run-off percentages in the table are shown the maximum salinity figures at representative delta stations for the corresponding years. Such figures as these can not of course be used as a direct comparison between stream flow and salinity behavior since the flow as represented by the run-off percentages was measured at foothill stations and between these stations and the delta there has been a large and variable irrigation draft. The results would appear to be somewhat inconsistent, indicating that total annual run-off figures alone should probably not be used as a criterion for close estimates of salinity conditions.

TABLE 13.

Comparison of Total Stream Flow Tributary to San Francisco Bay and Maximum Salinities, 1919 to 1925, Inclusive.

Year	*Combined stream flow in per cent of normal	Maximum salinity in parts of chlorine per 100,000 at Delta Stations								
		O and A Ferry	Collinsville	Emmaton	**Three Mile Slough	Rio Vista	Antioch	Jersey	Webb Pump	Central Landing
1918-1919	71	....	240	60	....	15	105	60	....	....
1919-1920	48	981	890	474	415	235	762	346	168	80
1920-1921	108	650	384	66	30	....	251	42	....	....
1921-1922	97	574	370	44	....	4	260	33	....	6
1922-1923	70	518	358	19	17	5	239	34	....	4
1923-1924	27	1,345	1,150	802	692	608	1,080	708	414	288
1924-1925	78	762	448	136	81	21	356	81	24	10
1925-1926	55	1,100	1,020	540	430	256	920	470	147	98

*For entire drainage to San Francisco Bay as measured at foothill stations at edge of valley.
**Ferry 1919 to 1925, inclusive; Bridge 1926.

APPENDIX B.

RETURN WATER.

As a result both of the cycle of dry years through which the Sacramento-San Joaquin valleys have been passing and the greatly increased irrigation development, the flow of both the Sacramento and San Joaquin rivers in the lower stretches has consisted almost entirely in recent years of water returned to the streams from upper irrigation operations. As a result development on the lower stretches of the rivers and in the delta has become greatly dependent upon this return water. It is important, therefore, that its quantity and extent be measured and recorded, and with the addition of each season's measurements to the record, the latter comes to be more and more reliable in the planning of new developments.

Preceding Reports.

Investigations of these return waters in the San Joaquin Valley have been conducted by the Division of Water Rights since and including the 1920 season and reports of this work up to and including the 1924 season have been published in the two preceding biennial reports and in Bulletin No. 1 of the Division. Beginning with the 1924 season, this work has been conducted through the office of the Sacramento-San Joaquin Water Supervisor and also, beginning in that year, it has included extensive return water investigations in the Sacramento Valley. Description and results of this work have therefore been published also in the 1924 and 1925 reports of the water supervisor. The matter here presented will be concerned only with the investigations of the past biennium.

TABLE 14.

Measured Return Flow in Definite Channels Tributary to Sacramento River 1925 and 1926.

From records for Butte Slough, District 70 Drain, District 108 Drain, Back Borrow Pit at Knights Landing, Sacramento Slough, Natomas Pritchard Lake Drain, Conaway drainage, District 1000 Drain and Back Borrow Pit of District 1000.

	1925		*1926*	
Month	*Acre-feet*	*Average second-feet*	*Acre-feet*	*Average second-feet*
June	*76,591	1,290	82,980	1,394
July	67,604	1,120	73,387	1,192
August	59,848	990	92,686	1,508
September	91,542	1,540	96,945	1,630
October	40,929	678	**	**
Total	336,514	1,101	***345,998	***1,430

* Considerable portion of June inflow probably derived from natural run-off.
** Record not available in time for this report.
*** October not included.

Sacramento Valley Return Water.

Along the Sacramento River, beginning as far up as a point a short distance below Colusa, there are a number of well defined channels discharging return water from irrigation back to the river. During the past biennium, the discharge of all such channels has been recorded throughout the irrigation season in much the same manner as reported for the 1924 work. In downstream order of their discharge to the river these channels are as follows: Butte Slough, Reclamation District 70 Drain, Reclamation District 108 Drain at Rough and Ready Bend, the Back Borrow Pit of reclamation districts 108 and 787 (carrying water from Colusa Basin) entering the river just above Knights Landing, Sacramento Slough joining the river just above its confluence with the Feather River (carrying Reclamation District 1500 drainage and drainage down the east and west borrow pits of the Sutter By-pass), Conaway Ranch drainage (discharged to the river through the irrigation plant in the latter part of the season), Natomas-Pritchard Lake Drainage (end of season only, similar to Conaway), Reclamation District 1000 Drain, and the Back Borrow Pit of Reclamation District 1000. On the upper end of the Sacramento River between Redding and a point below Cottonwood there is also considerable return from the irrigation of the Anderson-Cottonwood Irrigation District. This return water reaches the river through the natural creeks in this territory and enters above the Red Bluff (Iron Canyon) gaging station. A summary of the water returned to the Sacramento River below Red Bluff, as measured at the definite return channels above enumerated, is given in Table 14 for the 1925 and 1926 seasons. The results shown for June, 1925, probably include a considerable amount of water derived from natural run-off. Data were not available so that, for this month, a segregation of the discharge could be made as between water returned from irrigation and that derived from natural run-off. The latter occurred considerably later in the season in 1925 than in either 1924 or 1926.

Relation of Return Water to Irrigation Draft.

Of the return flow entering the Sacramento River through Butte Slough, nearly all is that resulting from Feather River diversions through the Western and Sutter Butte canals. Likewise, of the discharge to the river through Sacramento Slough, that portion derived from the East Borrow Pit of Sutter By-pass (measured near Chandler Station) is practically all return water from Feather River irrigation. In any study, therefore, of the relation between the return water and the Sacramento River diversions only, it is necessary to exclude that portion of Sacramento Slough discharge above noted as well as practically all of the return through Butte Slough. This relation of the return water to the irrigation diversions from which it is derived for the Sacramento River for the period July to October, inclusive, 1925, is shown in Table 15. In the computations for this table the figures for June were not included because of the occurrence in that month of natural run-off in the return channels as previously noted. It should be observed that in Table 15 the figures are for the return water actually measured at the well defined return channels previously named and no inclusion has therefore been made of seepage return along the river which can not be directly measured and which probably is a considerable quantity.

On Plate 33 a comparison of the accumulative return flow and draft coming downstream along the river from Red Bluff to Sacramento is shown for the period July to October, 1925, inclusive.

TABLE 15.

Relation Between Return Water and Draft, Sacramento River, Red Bluff to Sacramento, July to October, 1926 (Using Only Return Water Which Entered Through Definite Measured Channels*).

	July		August		September		October		July to October, inclusive	
	Acre-feet	c. f. s.	Acre-feet	c. f. s.	Acre-feet	c. f. s.	Acre-feet	c. f. s.	Acre-feet	c. f. s.
RETURN.										
Reclamation District 70 Drain	3,070	50	3,380	55	944	16	905	15	8,299	34
Reclamation District 108 Drain	2,650	43	2,580	42	721	12	509	8	6,460	26
Colusa Basin drainage at Knights Landing	24,100	392	26,900	439	51,100	860	15,600	254	117,700	482
Sacramento Slough (less flow down East Borrow Pit-Sutter By-Pass)	17,200	280	16,200	263	15,500	260	3,930	64	52,830	217
Conway Drainage					776	13	687	11	1,163	6
Reclamation District 1000 Drain	776	13	948	15	2,720	46	2,600	42	7,044	29
Total return	47,796	778	50,008	799	71,761	1,207	24,231	394	193,796	794
Total diversions, Red Bluff to Sacramento	188,100	3,070	171,600	2,790	113,600	1,910	13,560	221	487,160	2,000
Return in percent of diversions	25%		29%		63%		180%		40%	

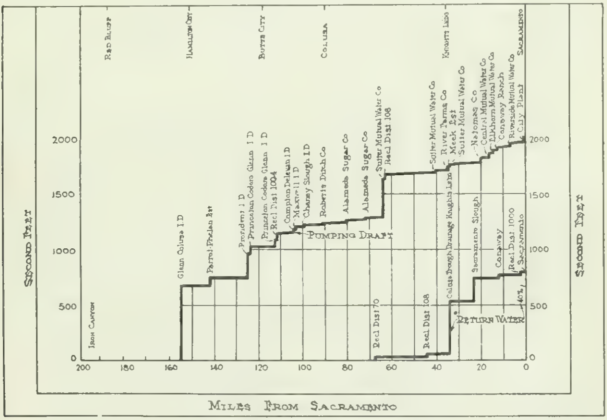
*Does not include seepage accretions along the river not susceptible of direct measurement.

NOTE. In order to show return water from Sacramento River irrigation only, the discharge to the river of return through Butte Slough and a portion of that through Sacramento Slough, derived from Feather River diversions, are excluded.

Return for the month of June is excluded from this table as the return channels were carrying considerable natural run-off during that month.

Comparison of 1925 and 1926 Return Water.

It will be noted that the 1926 return flow was considerably in excess of that during the 1925 season. However, this was to be expected as a result of the much greater rice acreage under irrigation during 1926. Whereas, in 1924 and 1925 there were approximately 100,000 acres of rice in the Sacramento Valley, in 1926 the rice area was increased to nearly 150,000 acres. But although the total return water in 1926 was greater, it is expected that the determination of its relation to the irrigation draft (which will not be available until the computations for the 1926 diversions have been completed) will show a percentage of return less than that for 1925. The percentage of return in 1925 was greater than that in 1924, probably due to the fact that there was a greater flow in the river in 1925 and with a less urgent demand for conservation, the conduct of irrigation operations was such as to entail more or less waste. The greater quantity of return water in 1926 over that in 1925 is indicated in Table 16 giving the discharge of the Colusa Trough at the Colusa-Williams Highway for these two seasons. The return water at this station is that from a representative Sacramento Valley rice and general crop area of about 185,000 acres. In 1925 for the period June to October, inclusive, the return water from this area was found to be 38 per cent of the diversions.



CUMULATIVE DRAFT AND RETURN FLOW SACRAMENTO RIVER
RED BLUFF TO SACRAMENTO JULY 1 TO OCTOBER 31, 1925.

This return water diagram represents return water only which entered through definite measured return channels. It does not include, therefore, seepage or return water which could not be directly measured.

NOTE—In order to show return water from Sacramento River irrigation only, the discharge to the Sacramento River of the Feather and American rivers is excluded, as is also return through Butte Slough and a portion of the return through Sacramento Slough derived from Feather River diversions.

PLATE 33

San Joaquin Valley Return Water.

In each of the seasons of 1925 and 1926 three series of return water measurements were made along San Joaquin Valley streams. As in former years each series comprised measurements beginning at the foothills and working downstream on the San Joaquin, Stanislaus, Tuolumne and Merced Rivers and on Dry Creek. The dates of the measurements in these series were as follows:

Dates of San Joaquin Valley Return Water Measurements.

Series	*1925*	*1926*
First	July 23–July 30	July 12-July 21
Second	Aug. 28–Sept. 5	Aug. 22–Aug. 30
Third	Sept. 27–Oct. 6	*Sept. 27–Sept. 30

* On the third series in 1926 "end measurements" only were taken, i.e., at the lowest station for each stream.

TABLE 16.

Return Water in Colusa Trough at Colusa-Williams Highway, 1925 and 1926.

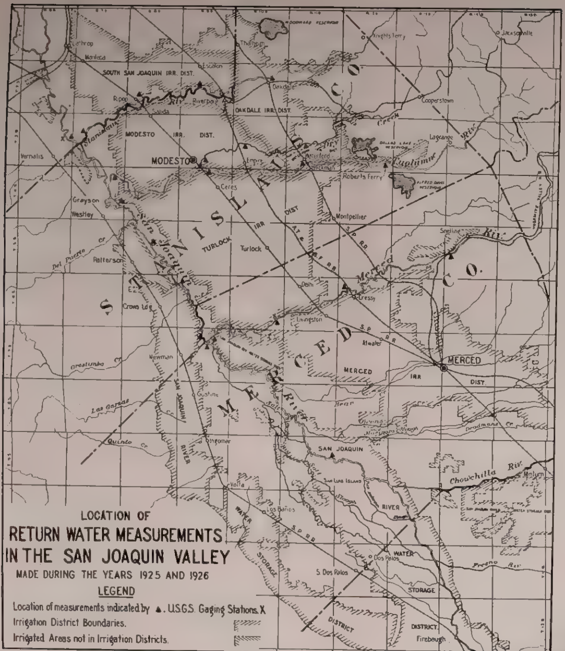
Day	Daily discharge in second-feet							
	June		July		August		September	
	1925	1926	1925	1926	1925	1926	1925	1926
1	374	507	479	507	324	499	479	609
2	401	536	491	513	302	531	570	565
3	465	507	474	513	294	528	540	690
4	518	478	516	513	301	525	538	788
5	573	464	566	481	333	551	586	716
6	540	484	580	432	325	586	658	684
7	510	441	536	389	325	565	699	681
8	498	427	481	438	320	554	756	623
9	456	510	442	421	338	600	764	574
10	364	539	388	413	338	618	756	545
11	378	542	348	410	426	658	720	539
12	354	542	268	424	424	693	668	525
13	370	542	236	416	456	707	621	528
14	366	565	230	446	410	722	603	586
15	395	589	225	418	384	710	626	577
16	406	583	225	387	388	702	665	507
17	447	571	277	374	415	699	660	490
18	463	586	338	356	415	716	655	473
19	491	577	308	311	422	699	686	458
20	461	571	301	309	388	728	642	387
21	489	594	320	334	428	722	603	391
22	493	583	324	338	424	722	603	394
23	491	571	311	331	368	788	583	376
24	479	568	322	360	378	800	553	316
25	496	551	320	362	406	812	558	280
26	456	539	333	362	428	803	578	231
27	433	522	342	370	392	836	540	222
28	422	516	362	374	390	866	508	221
29	410	522	368	416	397	833	491	181
30	424	522	362	435	415	761	461	173
31	....	....	360	452	440	699	....	....
Mean	447	535	369	407	380	*685	*612	*478
Acre-feet for month	26,600	31,800	22,600	25,000	23,400	42,000	36,400	28,400

*Drainage of rice fields commenced earlier in 1926 than in 1925.

Note.—This is return water flowing in the main drain of Reclamation District 2047; it is drainage chiefly from lands irrigated by Glenn-Colusa, Provident, Princeton-Corora-Glenn, Compton-Delevan, and Maxwell Irrigation Districts.

Points of Measurement.

The locations of the points of measurement were practically the same as in the past. These points are shown on the accompanying Plate 34.



LOCATION OF RETURN WATER MEASUREMENTS IN THE SAN JOAQUIN VALLEY

MADE DURING THE YEARS 1925 AND 1926

LEGEND

Location of measurements indicated by ▲. U.S.G.S. Gaging Stations, X

Irrigation District Boundaries. ▨

Irrigated Areas not in Irrigation Districts. ▨

PLATE 34.

This plate indicates also the areas from which the return water is derived by showing the boundaries of irrigation districts and the irrigated areas without district boundaries. It should be noted that in both years during each series of measurements the Merced, Tuolumne and Stanislaus rivers and Dry Creek were dry at the edge of the foothills and the San Joaquin River was dry at San Luis Island Ranch below the head of Temple Slough. Also there was practically no storage in the foothill reservoirs of the Modesto and Turlock irrigation districts during the season of measurements.

Summary of Results 1925 and 1926.

Table 17 gives the results of the measurements at the lowest points on each of the streams for each series in the 1925 and 1926 seasons. Since, at the time of the measurements, the streams were dry at some upper point, it is clear that the sum of the flow measured at the lowest point and the diversions between that point and the upper dry location represents the total return water for the stream as shown in the last column of Table 17. At the time of the measurements note was taken of all pumps in operation and estimates of their diversions were based upon rated capacities modified in accordance with observation and knowledge of actual operating conditions.

TABLE 17.

Return Flow in San Joaquin Valley Streams, 1925 and 1926.

(Cubic feet per second.)

Stream	1925				1926			
	Date	Measured flow	Total diversions	Total return	Date	Measured flow	Total diversions	Total return
San Joaquin River:								
Vernalis Gaging Station	July 27	1,210	*159	1,369	July 19	700	*188	888
	Sept. 1	690	*117	807	Aug. 29	595	*193	788
	Oct. 1	**1,044	*24	1,068	Sept. 30	595	*131	726
Stanislaus River:								
2 miles above San Joaquin River	July 27	232	0	232	July 20	111	13	124
	Sept. 1	151	0	151	Aug. 30	139	22	161
	Oct. 1	199	7	206	Sept. 30	101	29	130
Tuolumne River:								
3 miles above San Joaquin River	July 27	347	13	360	July 13	295	17	312
	Sept. 1	299	13	312	Aug. 26	286	10	296
	Oct. 6	**423	0	423	Sept. 30	317	0	317
Dry Creek:								
One-half mile above Tuolumne River	July 30	32	0	32	July 19	32	0	32
	Sept. 3	40	0	40	Aug. 28	31	3	34
	Oct. 5	42	0	42	Sept. 28	......	0	......
Merced River:								
One-half mile above San Joaquin River	July 24	131	89	220	July 15	90	50	140
	Aug. 29	73	43	116	Aug. 24	53	88	141
	Sept. 29	91	37	128	Sept. 29	73	38	111

*Includes diversions from San Joaquin River only.

**The mean daily release of 276 second-feet from La Grange Power Plant during this series (not return water) has been subtracted from the measured flow to give this figure.

During the last series of measurements in 1925 on the Tuolumne River, the power plant at La Grange Dam was being operated by the Turlock Irrigation District. By this operation an average daily discharge of 276 second-feet which was not return water was released to the river and this discharge has therefore been subtracted from the measured flow to give the figures for this series for the Tuolumne and San Joaquin rivers as shown in Table 17.

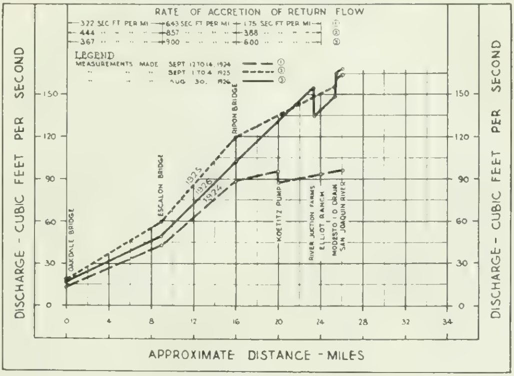
In September, 1926, between the second and third series of measurements the Turlock Irrigation District was again operating its power plant thereby augmenting the Tuolumne River flow and that of the San Joaquin River at the Vernalis gaging station. The record for the latter station shows the increased flow due to the power water release beginning about September 4th and ending about September 25th and in this period the discharge increased from 630 second-feet to 920 second feet. While this is not return water from irrigation it is of importance to note that with the development of irrigation storage and by-product power on San Joaquin Valley streams much needed additional flow in certain periods throughout the season may become available to the lower river and delta region through the power operations.

Accretion Charts.

The accretion charts, Plates 35, 36 and 37, present graphically for each stream a comparison of the return water in the 1924, 1925 and 1926 seasons as measured in the period at the latter part of August and first of September in each year. The rates of accretion of flow are indicated for the various sections between points of measurements on each stream.

RATE OF ACCRETION OF RETURN FLOW IN STANISLAUS RIVER

MEASUREMENTS MADE UNDER DIRECTION OF DIVISION OF WATER RIGHTS



IN TUOLUMNE RIVER

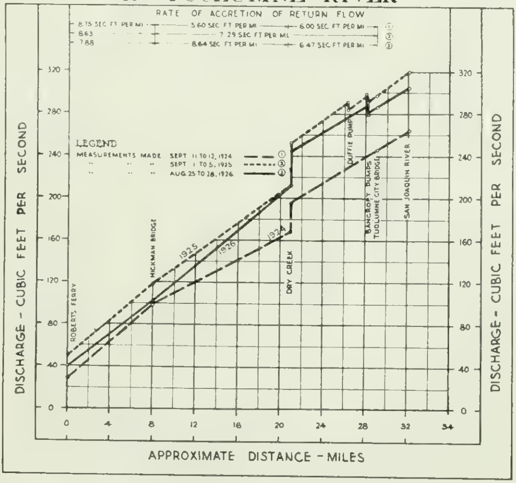
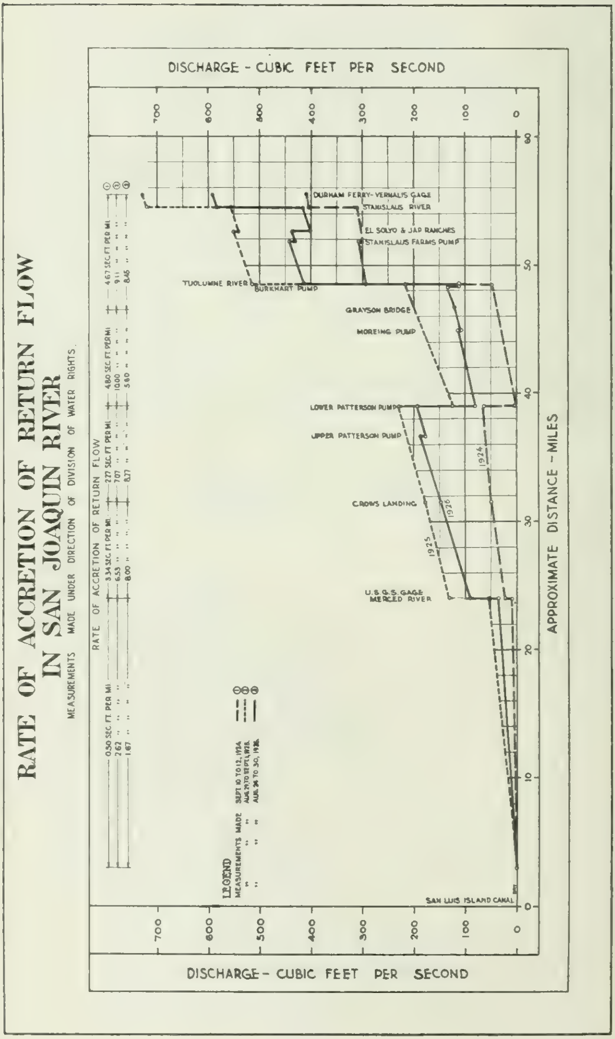


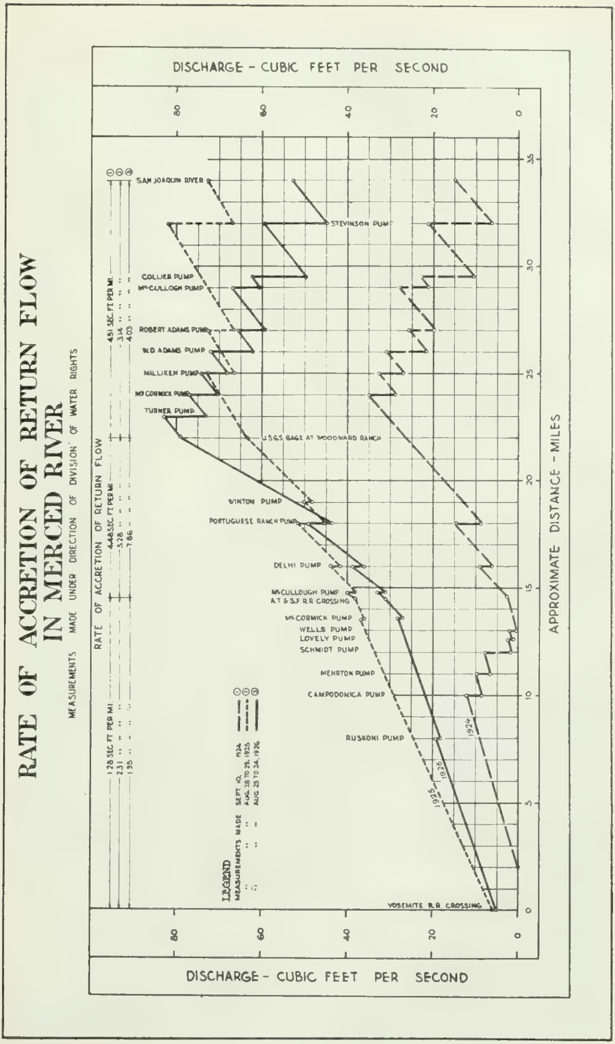
PLATE 35.



RATE OF ACCRETION OF RETURN FLOW IN SAN JOAQUIN RIVER

MEASUREMENTS MADE UNDER DIRECTION OF DIVISION OF WATER RIGHTS.

PLATE 36.



RATE OF ACCRETION OF RETURN FLOW IN MERCED RIVER

MEASUREMENTS MADE UNDER DIRECTION OF DIVISION OF WATER RIGHTS

PLATE 37.

APPENDIX C.

DELTA DUTY OF WATER.

A REPORT OF COOPERATIVE IRRIGATION INVESTIGATIONS IN THE SACRAMENTO-SAN JOAQUIN RIVER DELTA IN 1925 AND 1926.

By O. V. P. Stout, Irrigation Engineer, Division of Agricultural Engineering,
U. S. Department of Agriculture.

Irrigation investigations in the Sacramento-San Joaquin River Delta continued in 1925 and 1926, as in 1924,[1] a part of a cooperative undertaking to which the formal or subscribing parties were as listed below:

United States Department of Agriculture, Bureau of Public Roads, operating through the Division of Agricultural Engineering.

University of California, Agricultural Experiment Station, operating through the Division of Irrigation Investigations and Practice.

State of California, Department of Public Works, operating through the Division of Engineering and Irrigation.

State of California, Department of Public Works, operating through the Division of Water Rights.

In addition to these, the Permanent Committee of the Sacramento-San Joaquin River Problems Conference has contributed funds and an active and helpful interest.

The field work in the delta has been done in territory of the Holland Land Company, Reclamation District 999, and the California Delta Farms, Inc. The officers and employees of all of these have at all times accorded the most liberal and thorough cooperation.

PEAT LANDS—1925.

The principal new feature of the investigation in 1925 relative to irrigation of the peat lands was the introduction of observations on the amount of water used by plants growing in tanks. The investigation of field crops was continued on Medford Island and also taken up on King Island. In 1926 the work on Medford Island was discontinued, as it appeared that the work of the two preceding years had developed some definite points, and that the amount and value of the work on the peat lands would be enhanced by concentrating on King Island. The tanks on Medford Island were therefore transferred to Reclamation District No. 999, additional tanks were secured for King Island and the field observations on that tract extended.

Medford Island Field Irrigation in 1925.

Practically the entire island in 1924 was planted to potatoes, and the figures already reported for that year refer to that crop. In 1925 the greater part of the 1200 acres contained in the island was in barley and was not irrigated. Some data on the use of water by that crop are offered as a result of the tank work. The west side of the island, to the extent of 93.55 acres, was in potatoes. The water admitted to this area from the channels was measured throughout the irrigation season of 51 days, from May 26th to July 16th, inclusive, as was also the water drained from the field during the same period. From the accompanying graph of Accumulated Net Irrigation, Plate 38, it appears that for the entire 51-day period the water admitted to this field for irrigation exceeded that drained from it by an amount equivalent to 0.25 acre-feet per acre, or 3 inches in depth over the field; that from the beginning of the period on May 26th until June 24th the excess of water admitted to the field over that drained from it accumulated at a fairly uniform rate, and that during the greater part of the balance of the irrigation season the water was draining away at a greater rate than it was admitted from the channels. Consequently, if the net accumulated irrigation be reckoned as of June 24th it will be found to be considerably in excess of that reckoned to the close of the irrigation season, the figures being 0.43 acre-feet per acre for the shorter period as against 0.25 acre-feet per acre for the longer period. It is manifest that the accumulated net irrigation at any time on this field does not represent the entire use of water by the crop, nor more than a small part of it. In 1924, when nearly the entire island was in potatoes, it was computed from the measurements made of water admitted for irrigation and of that discharged by the drainage pump,

---

[1] For published report of work in 1924 see Division of Water Rights Bulletin No. 4, Water Supervisor's Report, 1924, by Harlowe M. Stafford, pp. 187–199, inclusive. Also, appendix D, Part (c), of the Biennial Report of the Division of Water Rights dated November 1, 1924.

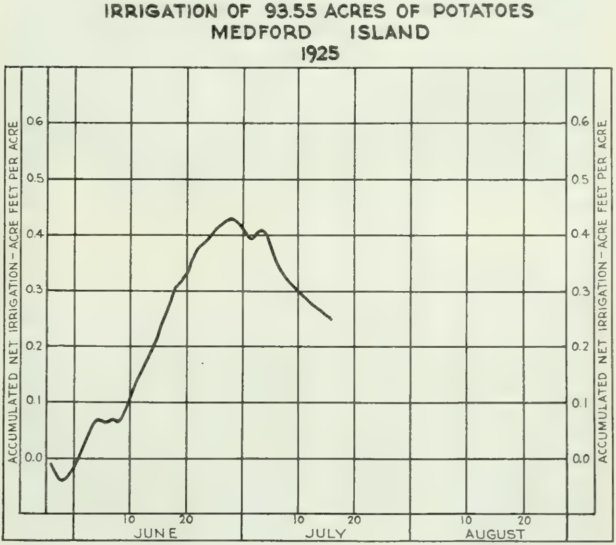
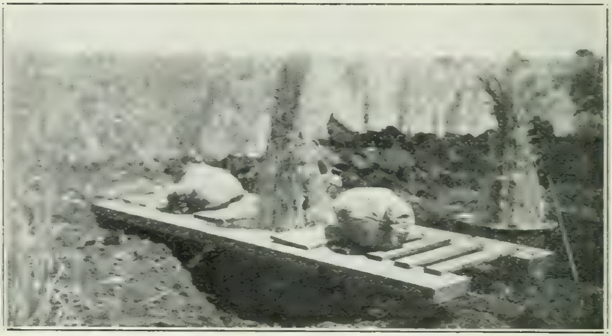

IRRIGATION OF 93.55 ACRES OF POTATOES
MEDFORD ISLAND
1925

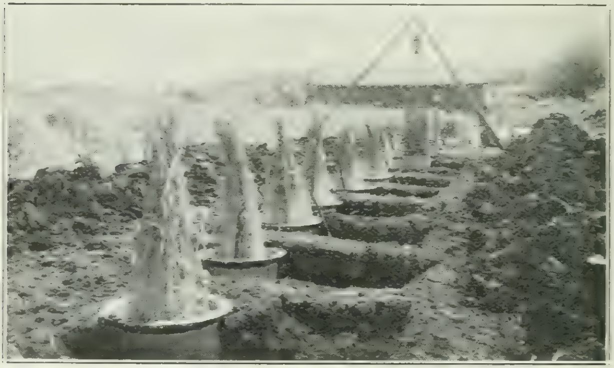
PLATE 38.

that the net use of water in irrigation for the season was the equivalent of 0.18 acre-feet per acre of the 1100 acres in potatoes or a little more than 0.16 acre-feet per acre of the entire area of the island. The records of the two years therefore agree in indicating that the irrigation and drainage works on Medford Island serve chiefly to secure uniform distribution of the water supply, and that the seepage, from whatever source or sources it is derived, whether by percolation beneath the levees or forced up by pressure from beneath, is sufficient in amount, or nearly so, to meet the water requirements of crops.



WEIGHTED PLATFORM USED IN FORCING INNER CYLINDER TANKS DOWN INTO PEAT, MEDFORD ISLAND, 1925.

PLATE 39.



TANK INSTALLATION, MEDFORD ISLAND, 1925.

Inner cylinders of tanks filled and ready to lift. Note texture of excavated soil.

PLATE 40.

Medford Island Tank Work in 1925.

Twelve tanks, numbered from 17 to 28, inclusive, were placed on Medford Island. Plates 39 and 40 show the process of installing these tanks, and their appearance when in place. They consist of an outer water-tight cylinder, within which is placed an inner cylinder of smaller diameter, filled with soil, and having openings in and near the bottom through which water introduced into the annular space between the cylinders enters the soil in the inner cylinder. The inner cylinder has a detachable bottom. In order to fill the cylinder with soil, it is forced into the ground, the detachable bottom is put in place, the cylinder lifted by means of a derrick, the larger or outer cylinder placed under it, and the smaller cylinder lowered. The water for irrigation is applied through the annular space between the cylinders. This annular space is sealed at the top, so that all loss of water from the tank is accounted for by transpiration of the plants, if any, growing in the tank and by evaporation from the surface of the soil in the inner cylinder. On Medford Island the smaller cylinders were pressed down in the barley field in such manner as to retain the barley stand on the soil area included by the cylinder. This work was done on May 6th at which time the barley was already headed out, but not yet in the milk. The barley was removed from tanks Nos. 17 and 20, inclusive, and they were kept bare of all growth during the period of observation, in order to segregate the portion of water lost from the tanks which

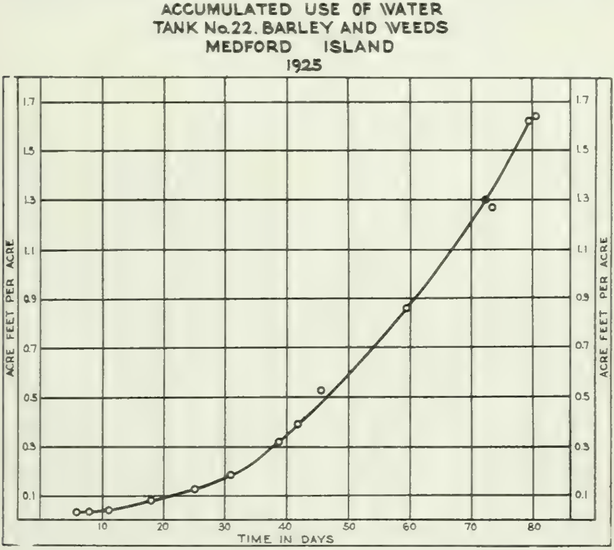


PLATE 41.

should be charged to evaporation from the soil surface. Tanks Nos. 21 to 28, inclusive, in which the barley was left to mature, soon developed a considerable growth of weeds. Inasmuch as the tanks were installed for the purpose of obtaining an estimate of the water disposed of by the field of barley, and as the field contained the same kinds of weeds in apparently the same amount, the weeds in the barley tanks were not disturbed until the barley was harvested, at which time they were cut and the weight of dry matter was determined for the weeds as well as for the barley. An analysis of the observations and results shows that the chief demand for water during the period of observation came from the weeds. The barley was approaching maturity of growth at the time the tanks were installed, and soon yielded to the weeds its precedence in demand on soil and water. It is therefore desirable that the use of water by the barley and that by the weeds should be segregated, if possible to do so. Table 18 gives the observed data.

TABLE 18.

Observed Data, Medford Island Tanks, 1925.

Tank No.	*Dry matter barley (grams)*	*Dry matter weeds (grams)*	*Water used*[1] *(measures)*
21	398.2	83.5	93.80
22	322.2	183.0	134.78
23	317.3	34.5	45.69
24	267.7	30.0	40.37
25	318.5	88.5	79.23
26	360.5	32.0	61.18
27	306.7	154.5	108.72
28	353.7	75.0	70.76

[1] The water used, as noted in above table, has been computed as the sum of the number of measures of water actually added to the tank during the period of observation and the number of measures of water corresponding to the sinkage of the water surface in the annular space in the tank. This takes no account of rainfall nor of the depletion of soil moisture above the water table in the inner cylinder of the tank.

Segregation of Use of Water.

Let b=measures of water which was used by barley, per gram of dry matter.

w=measures of water which was used by weeds, per gram of dry matter.

e=measures of water evaporated from the soil of one tank.

d=measures of water equivalent to the depletion of soil moisture above the water table in one tank.

r=measures of water equivalent to the rainfall on the soil surface of one tank.

Then if $e + d - r = E$, we shall have for each tank an equation of the form written below for tank No. 21:

$$398.2\ b + 83.5\ w + E = 93.80$$

Thus we shall have eight equations involving the three unknown quantities, b, w, and E. The eight equations have been used to obtain adjusted values of these unknown quantities, with results as written below:

$$b = 0.19357;\ w = 0.54076;\ E = -30.74$$

The rainfall during the period of observation amounted to 0.68 inches, equivalent on one tank to 4.85 measures of water, the content of the measure being 0.0339 cubic feet.

Therefore, according to the above derived value of E, we have

$$e + d = -30.74 + 4.88 = -25.86$$

We know that evaporation is positive. Therefore, according to this analysis, the depletion of soil moisture above the water table must be negative; in other words, the moisture in the soil above the water table was greater in amount at the end of the period of observation that it was at the beginning. Samples of the soil taken in December of 1924, from above the water table in the field in which the tanks were placed, indicated an average moisture content of 29 per cent by volume. To account for the negative value of E might require a change in moisture content of the $8\frac{3}{4}$ cubic feet of soil above the water table, equivalent to 15 per cent of the volume of the soil, equal to 1.3 cubic feet, or 38.5 measures. It seems reasonable to suppose that such a change may have taken place.

If, as computed, b is equal to 0.19357, the barley during the period of observation used 186 pounds of water for each pound of dry matter produced. The value w=0.54076 corresponds to 520 pounds of water used by the weeds for each pound of dry matter produced. As has been noted, the use of water by the barley covers only the filling and ripening stage. The greater part of the weeds started after the tanks were placed, and at the time of cutting were well grown but not mature.

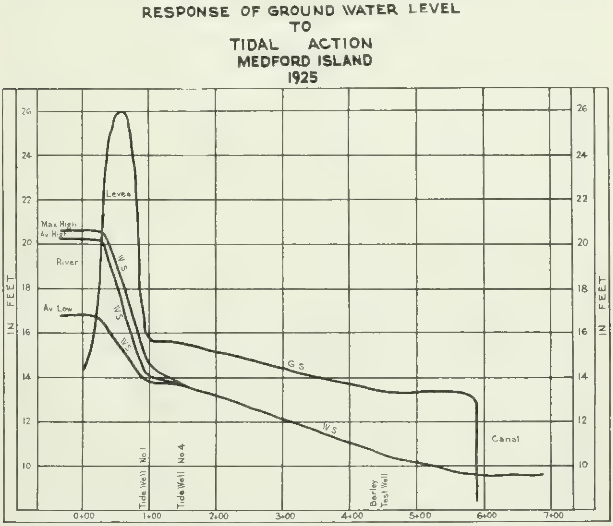


PLATE 42.

By means of the observations which were made and recorded, it is possible to compute the accumulated use of water by any tank up to any day of the period of observation, except as it may be affected by variation in the moisture content of the soil above the water table. A graph of this nature has been prepared for tank No. 22, Plate 41, the largest user of water and the largest producer of weeds, and is presented herewith. The graph reflects clearly the increasing rate of use of water as the weeds increase in size and water-using capacity.

The losses of water from the bare tanks are complicated or made impossible by the uncertainty as to difference in moisture content in the soil above the water table at the beginning and the end of the series of observations. For the four tanks, Nos. 17 to 20, inclusive, the respective algebraic sums of evaporation from the soil surface and depletion of water between the soil surface and the water table are found to be 15.19, 17.83, 21.18 and 13.03 measures of 0.0339 cubic foot each, or an average of 16.81 measures. These figures take account of the equivalent of 4.88 measures of rainfall on the soil surface of each tank. Here, again, in the light of figures obtained from bare tanks at King Island, it seems probable that the Medford tanks contained more moisture above the water table at the end of the period than at the beginning.

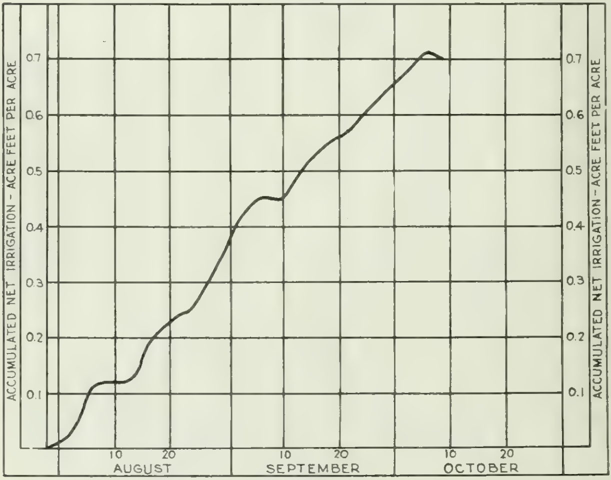

IRRIGATION OF 21.97 ACRES OF POTATOES
KING ISLAND
1925

PLATE 43.

The aim was to keep the water table in the barley tanks at about the same depth below the ground surface as it was in the field, and this was closely approximated.

Incidental Work on Medford Island in 1925.

In order to test the responsiveness of the elevation of the water table to the tides, four wells were put down at intervals of 15.3, 16.6 and 19.1 feet out from the inside toe of the south levee, and record was kept of the elevation of the water surface in all of them, the first and fourth wells being equipped with water stage registers. In connection with these wells, a record was also kept of the elevation of the water surface in a well about 600 feet distant in the barley field. Well No. 1, at the toe of the levee, showed itself to be immediately responsive to the tides. The evidence of immediate responsiveness to tides was less and less in the various wells as distance from the levee increased, and it was only a short distance to where it was not recognizable. Plate 42 herewith shows this fact.

King Island Field Irrigation in 1925.

A complete record was secured of the irrigation of a field of late potatoes near Camp 3½ on King Island. The area of the field is 21.97 acres. In preparation for the potatoes the field had been burned before plowing, a light burning designed to consume two or three inches in depth of soil being all that was attempted. The ground was irrigated by pumping on to the surface in order to extinguish the fire. When the potatoes came up the foreman of the work estimated a 70 per cent stand. The irrigation season covered a period of seventy-two days extending from July 30th to October 9th, inclusive. The accompanying graph of Accumulated Net Irrigation, Plate 43, shows that the net use of water conformed to a nearly uniform rate during the entire period of irrigation, and amounted finally to 0.70 acre-feet per acre, or the equivalent of 8.45 inches in depth of water over the field. This is almost precisely one-fourth of the amount admitted to the irrigation ditches, the other three-fourths being drained off. Here, therefore, to some extent the same as at Medford Island, we must conclude that a part of the water required for the crop reached the field in the form of seepage unless it can be shown as a possibility that the crop could be raised with 9 inches of water plus whatever there may have been of depletion of soil moisture above the water table. The irrigation

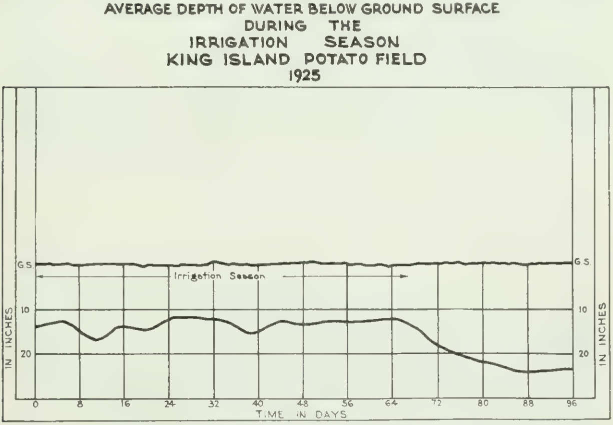
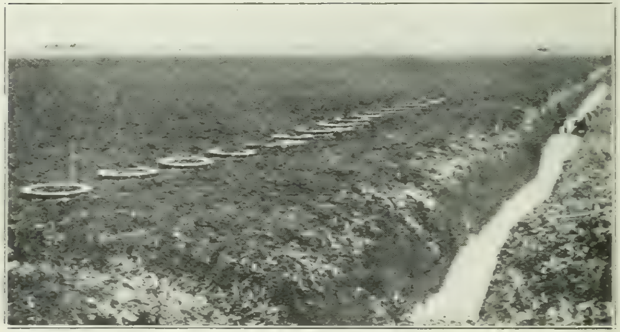


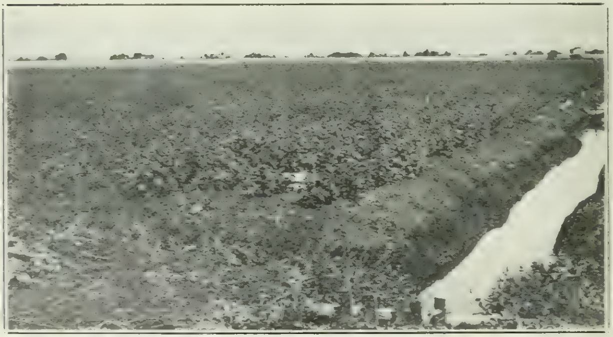
PLATE 44.

was effected by means of 18 spud ditches to which water was admitted from a head ditch and from which the water was drained into a tail ditch. The irrigation system was so disposed that it was possible by means of two weirs, each with a water-stage register, to obtain a continuous record of the water admitted to the field, and by means of two other weirs similarly equipped to obtain a similar record of the water drained from the field. The field yielded 2265 sacks of No. 1 potatoes, and 336 sacks of No. 2's. During the irrigation season the water table was kept at an elevation only 11 to 16½ inches below the surface of the ground—averaging 13.7 inches—as shown by the accom-



KING ISLAND TANKS IMMEDIATELY AFTER INSTALLATION MAY 14, 1925.

PLATE 45.



KING ISLAND TANKS JULY 11, 1925.

Note that potatoes growing in tanks cannot be distinguished from those in adjacent ground; a very satisfactory simulation of natural conditions.

PLATE 46.

panying graph, Plate 44, which shows the average elevation of the water table at four points located at the approximate centers of the four quarters of the field.

King Island Tank Irrigation in 1925.

Sixteen tanks, of the same type and dimensions as those used at Medford Island were placed in the southeast corner of a potato field in the northwest part of the island. Plate 45 shows them immediately after installation, and Plate 46 shows the growing crop in the tanks and on adjacent ground. The tanks were numbered 1 to 16, inclusive. Four of them were kept bare of vegetation and potatoes were planted in the other twelve. Of the twelve tanks, four were covered in order to confine the water loss to the transpiration by the plants, and were irrigated with water from the adjacent irrigation ditch; four of the remaining eight were irrigated with water from the ditches and four with water from the drain on Medford Island. The water table was kept at approximately the same distance below the ground surface in the tanks as in the field. Potatoes were planted in the twelve tanks and in the immediate adjoining portion of the field on May 14th. The field as a whole was planted about ten days earlier. The period of observation extended from that date to October 26th. The potatoes in the field were harvested early in September, but those in the tanks were not removed until about the close of the period of observation, at which time it was found that nematodes had destroyed a good many of them. In order to make an estimate of the yield it was necessary to replace the damaged potatoes by sound ones of the same size. Preliminary experiments proved that this could be done with a very small percentage of error.

The subjoined Table 19 sets forth the results of the tank experiments at King Island in 1925:

TABLE 19.

Results of Experiments with Tanks at King Island in 1925.

Tank number	Water used (measures)	Weight of tops (grams)	Weight of potatoes (grams)	Pounds of water per pound of tops	Acre-feet per acre
1	178	281.0	169.4	448	2.08
2	224	194.7	1,194.2	1,106	2.62
3	155	159.1	634.8	652	1.81
4	113	99.3	862.4	638	1.32
5	52	......	......	......	.61
6	42	......	......	......	.49
7	113	99.1	736.5	640	1.32
8	47	......	......	......	.55
9	167	179.0	906.3	896	1.95
10	115	108.5	752.0	602	1.35
11	121	153.3	665.1	465	1.42
12	84	91.0	745.7	887	.98
13	98	90.7	642.6	541	1.15
14	47	......	......	......	.55
15	93	83.6	519.8	529	1.09
16	67	70.0	528.0	919	.78

Tanks Nos. 5, 6, 8 and 14 were bare, but became shaded by the growth of adjacent plants.
Tanks Nos. 2, 9, 12, and 16 were covered.
Tanks Nos. 1, 4, 10 and 13 were irrigated with water from the irrigation ditches.
Tanks Nos. 3, 7, 11 and 15 were irrigated with water from the main drain on Medford Island.

Table 20 presents for comparison the mean results from the tanks irrigated with water from the irrigation ditches and those irrigated with drain water.

In this table the pounds of water per pound of dry tops has been computed on the basis of the entire amount of water used by the tank in each case, less the evaporation from the soil surface, in the cases of the uncovered tanks. The mean loss from the bare tanks was 47 measures of water, and this had been taken as the amount to be subtracted on account of evaporation. The mean amount of water used by the covered tanks is 952 pounds per pound of dry tops. The mean of the corresponding quantities in this table for the uncovered tanks is 564 pounds of water for each pound of dry tops. If no allowance is made for evaporation the mean for the uncovered tanks is 934 pounds, nearly the same as for the covered tanks.

TABLE 20.

Use of Water from Irrigation Ditches and from Drains, King Island Tanks—1925.

Mean results per tank	*Ditch*[1] *water*	*Drain*[2] *water*
Yield of dry tops (grams)	144.9	123.8
Yield of potatoes (grams)	606.6	639.0
Water used[3] (acre-feet per acre)	1.48	1.41
Pounds of water used[4] per pound of dry tops	557	572
Pounds of water used[4] per pound of dry matter in tops and potatoes[5] combined	278	276

[1] This column contains mean results for Tanks Nos. 1, 4, 10 and 13.
[2] This column contains mean results for Tanks Nos. 3, 7, 11 and 15.
[3] Includes evaporation.
[4] Does not include evaporation.
[5] Dry weight of potatoes estimated at 20 per cent.

A graph has been prepared and is presented herewith, Plate 47, showing the accumulated use of water from tanks Nos. 1, 11, 8, 9 and 10.

The water table in the adjoining field and in the tanks during the period of observation ranged from one to two feet below the ground surface.

Other Work at King Island in 1925.

The only other work at King Island consisted of unsuccessful attempts to measure the velocity of the water seeping from under the levees, and ground water explorations in connection with that endeavor.

SEDIMENTARY LANDS—1925.

The work of the season of 1925 in the lower unit of Reclamation District 999 was directed to the same end as that of 1924, namely: the determination of the consumptive use of water in irrigation on the total net area of about 22,000 acres. The same methods were followed as in 1924, together with some additional features. In 1924 it was determined that the consumptive use of water was equivalent in amount to about twenty inches in depth over the area, with the addition of a decrement of ground-storage corresponding to a total decrease of about 37,000 acre-feet in the volume of soil lying below the water table. In comparing hereinafter the results of the two years, these figures are revised.

In 1925 the record of ground water elevation was kept in such manner and such supplementary determinations of soil moisture and of volume-weights of soils were made as to afford a basis for an estimate of the amount of water involved in difference of ground water levels at the beginning and end of the irrigation season. A 60-inch steel siphon was installed by the reclamation district at the main drainage pumping station in 1925, in order to supplement and in part to replace the pumping plant in siphoning water from Elk Slough for the irrigation of the lands. This necessitated a rating of the new siphon, which was made by means of the Collins Flow Indicator. The rating, however, fell short of covering the entire range of conditions under which the siphon operated. When it runs full, the discharge is a function of the difference in elevation of water surface in Elk Slough and in the main drainage channel through which the water flows to the lands. The system under which it is operated, however, permits the vacuum to become reduced, for hours at a time, to a point such that the siphon does not run full at the summit, and the discharge then is a function not only of the head, or difference of elevations of water surface in slough and drainage channel, but also of the vacuum. The reclamation district ordered a recording vacuum gage in order that the siphon might be rated for the periods of low vacuum and the records of discharge for these periods made with the same degree of accuracy as that which attaches to other parts of the work. Owing, however, to delay in the delivery of the recording gage, it was not installed in time to be of service for the season of 1925, except in so far as the brief record which was obtained afforded information from which an estimate has been made of the aggregate length of time during which the operation of the siphon was affected by the condition of low vacuum.

As a result of the work the following summary is submitted: In undertaking to allow for the low vacuum at the summit of siphons at the main drainage pumping station, two estimates of the season's total discharge at that plant were made, one being estimated as the minimum and the other as the maximum that was probable. The total discharge of the siphons under full vacuum, as computed, was 16,290.1 acre-feet. The estimated minimum, taking account of the low vacuum which obtained for a part of the time, is 65 per cent of the total above noted, or 10,588.5 acre-feet, and the corresponding estimated maximum, 85 per cent of the total above noted, is 13,846.5 acre-feet. The difference between the estimate of the maximum probable amount of water delivered by the siphons, and the corresponding estimate of the minimum probable amount is therefore 3,258.0 acre-feet the equivalent of an amount sufficient to cover the entire net irrigated area to a depth of 0.15 foot. There are therefore presented two estimates of the total recorded use of water in the district, which will differ from each other by 0.15 acre-foot per acre of area involved. This difference has been taken into account in preparing Table 21.

TABLE 21.

Use of Water in Lower Unit of Reclamation District No. 999.

	Minimum estimated (acre fect)	*Maximum estimated (acre-feet)*
Siphoned at Main Drainage Pumping Station	10,588.5	13,846.5
Pumped by various plants	9,281.8	9,281.8
Discharge through culvert at Willow Point Levee	1,906.8	1,906.8
Total water admitted to area	21,777.1	25,035.1
Pumped out at Plant No. 35	276.0	276.0
Total water used from pumps, siphons, and Willow Point Culvert from April 11th to November 3, 1925	21,501.1	24,759.1

These total amounts of water used are equivalent, respectively, to 0.981 and 1.129 acre-feet per acre on the net area of 21.924 acres which is involved.

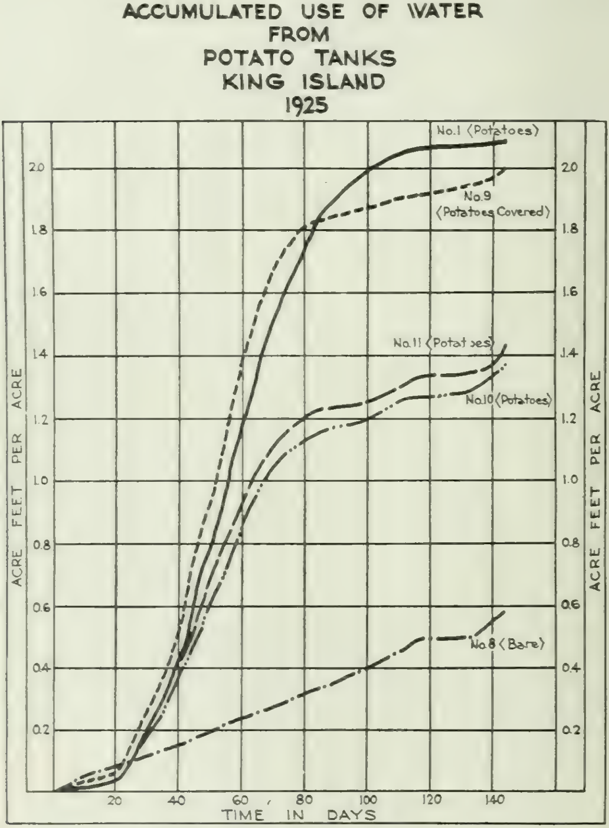


PLATE 47.

The depletion of ground water storage in the area during the same period of time, as reckoned from the observations which have been noted, amount to 6.256 acre-feet, equivalent to 0.285 acre-foot per acre of the net area. This constitutes an addition to the amount to be reckoned as consumptive use of water in irrigation, making the totals 1.266 and 1.414 acre-feet per acre, respectively. The rainfall during the irrigation season amounted to 2.06 inches, or 0.172 foot. The total consumptive use of water, reckoned as the sum total of all elements which have been determined, is therefore 1.438 or 1.586 acre-feet per acre, according as the minimum or maximum estimate of the amount of water siphoned into the district at the main drainage pumping station is taken.

The element of which no account has been taken in arriving at the figures for the consumptive use of water in Reclamation District No. 999 is whatever amount may have been derived from seepage under the levees surrounding the district or vertically upward from beneath the area. Although efforts made in 1925 to obtain measurements to afford a basis for an estimate of this item were unsuccessful, hope is still entertained that future efforts in this direction will meet with some measure of success. It has been ascertained that at least a portion of the district is underlain by a bed of gravel which has a direct connection with the water in the West Levee Borrow Pit, and that the elevation of the ground water in this region is immediately responsive to changes of elevation of the water surface in the borrow pit. Wells which were put down into this gravel, with their points about 35 feet below the surface of the ground, immediately adjacent to the West Levee near the Clarksburg road, became flowing wells during the season of high water in the channels in the winter of 1925-26. The land in this limited locality is covered with water at the time of high water in the channels. Some of the information which has been furnished regarding the materials penetrated by wells bored in the district indicates that the gravel stratum may underlie a considerable portion of the district, although at a greater depth than found at the point to which reference has been made.

Comparison with Results of 1924.

The report for 1924 states in conclusion that "it was determined that the water admitted to the tract through the siphons during the irrigation season of 1924 amounted to 23,599.9 acre-feet. The total amount of water admitted is the sum of the amounts admitted by means of the siphons and the pumps, respectively, or 41,689.3 acre-feet, equivalent to a depth of 1.774 feet over the area of 23,500 acres lying inside of the levees. Except as it may be modified by the undetermined increment or decrement of ground water storage for the season as a whole, this figure of 1.774 acre-feet per acre represents the consumptive duty of water on the lower unit of Reclamation District No. 999 in the season of 1924." It is also stated that "the decrement in the amount of completely saturated soil underlying the tract was 37,388 acre-feet."

As to the 41,689.3 acre-feet reported as the total amount delivered by means of the siphons and pumps, it is to be said that at the time that those figures were prepared no account was taken of a fact which was later discovered to be an element in the situation, namely: that the siphons are so operated that they do not run full at the summit at all times. If this element is taken into account in 1924 as in 1925, the figure of 41,689.9 acre-feet becomes 33,429.3 acre-feet as a minimum estimate, and 38,149.4 acre-feet as a maximum estimate. These revised figures, taken in connection with the revised figure of 21,924 acres for net area, correspond to a consumptive duty of water equal to 1.525 and 1.740 acre-feet per acre, respectively.

In the light of what was learned in 1925 concerning the equivalent of ground-water storage, it is believed that the lowering of the water table in 1924 to the extent of 1.59 feet, as an average over the area, corresponds to an additional consumptive use of water of 0.26 acre-foot per acre, as a fair figure. When this element is included in the total for the consumptive use of water during the irrigation season the revised figures for 1924 become 1.785 and 2.000 acre-feet per acre, respectively, for the minimum and maximum estimates.

Table 22 is appended to facilitate the comparison of the figures which have been given for the results of the two years.

TABLE 22.

Comparison of Determinations for 1924 and 1925 on Reclamation District 999.

	1924	*1925*
Net water pumped and siphoned (acre-feet)		
Minimum estimate	33,429.3	21,501.1
Maximum estimate	38,149.4	24,759.1
Net water pumped and siphoned (acre-feet per acre)		
Minimum estimate	1.525	0.989
Maximum estimate	1.740	1.129
Depletion of storage in soil (acre-feet per acre)	0.260	0.285
Rainfall (acre-feet per acre)	0.092	0.172
Seepage under levees (acre-feet per acre)	Not determined	
Total determined consumptive use (acre-feet per acre)		
Minimum estimate	1.887	1.438
Maximum estimate	2.092	1.586

TABLE 23.

Crop Acreage in the Lower Unit of Reclamation District 999 for the Season of 1925.

Orchard, including intercropped orchard	1,630 acres
Asparagus, including intercropped asparagus	3,290 acres
Alfalfa	3,149 acres
Beans, all varieties	8,114 acres
Beets	2,951 acres
Potatoes	1,051 acres
Peas	897 acres
Onions	970 acres
Commercial seeds	614 acres
Barley	339 acres
Nursery	30 acres
Vineyard	27 acres
Celery	110 acres
Total	23,172 acres

Of the 23,172 acres, 2010 acres were intercropped orchard and asparagus; 1290 acres were double cropped. There were small acreages of other crops such as tomatoes, cucumbers, corn, spinach and other truck crops. The remainder of the net area of 21,924 acres in the lower unit of the district is used for building sites, farm yards and lands not cropped.

This table was compiled from the records of lands under contract with the Holland Land Company together with field observations necessary to cover the entire unit.

INVESTIGATIONS IN 1926.

At this time (October, 1926) only rough approximate computations of the results of the greater part of the field work of 1926 are available. Consequently, instead of giving figures subject to revision, the findings on the points to which they relate will be given in the form of characterizations of results, or as approximate ratios to those determined on the same points for the preceding years.

PEAT LANDS—1926.

As hereinbefore noted, no work was done on Medford Island in 1926, and the investigations on peat lands were concentrated on King Island.

King Island Field Irrigation in 1926.

The methods of irrigation of the fields on King Island in 1926 were the same as those described for 1925. The devices and methods employed in measurement and observation were also the same.

The fields embraced in the investigation are as follows:

11.84 acres of potatoes. This field is the easterly portion of the field of 21.97 acres of potatoes reported for 1925.

18.38 acres of potatoes. This field lies east and across a main drainage channel from the 11.84-acre field. It was selected for observation because the main drains are so located as to lead to the expectation that lateral or horizontal seepage under the levee from the river channel to the field would be intercepted.

33.11 acres of corn. This field was selected in accordance with the scheme to include additional crops in the investigation from time to time, as conditions permit.

2.18 acres of celery. The extension of the investigation to the irrigation of celery was made for the same reason as in the case of corn.

The irrigation season has closed on all of the fields listed, except the celery.

The net use of irrigation water on both of the fields of potatoes observed is very much greater than on the 21.97-acre field in 1925. Apparently the number of acre-feet of water per acre, net use, is at least three or four times what it was in 1925. It was expected that on comparing the two fields in 1926, the net use per acre on the 18.38-acre field would be considerably greater than on the 11.84-acre field, on account of the interception of seepage by the drains, as has been noted. The preliminary figures on this point show a difference in the direction expected, but it is relatively small.

The irrigation season on the 21.97-acre field in 1925 extended over 70 days, from late July into October. On the two potato fields in 1926 the irrigation season was about 100 days in length, from middle and late May to September. These differences in dates and lengths of irrigation season may account in part for the greater use of water in 1926. It may be that when yields of potatoes for 1926 are available they will contribute further to the explanation which the figures demand. It is anticipated, however, that after giving due weight to these factors there will be a large residual of difference between the figures for net use of irrigation water on potatoes in 1925 and 1926, which can conceivably be accounted for only by a difference in seepage conditions in the two years.

During a part of the irrigation season on the corn field of 33.11 acres a portion of the water which it might have used to advantage was diverted to more valuable crops. The preliminary figures indicate that the net use of water, in acre-feet per acre, was about two-thirds of the average of that found for corn growing in tanks.

No computations relative to the 2.18 acres of celery under observation have as yet been made, as irrigation is still in progress on that crop.

King Island Tank Work in 1926.

At the close of the season of 1925, it appeared that the ground in which the sixteen tanks had been set was infested with nematodes, and was in some additional respects lacking in suitability to the purposes of the investigation. With a view to escaping these conditions the tanks were moved, prior to the opening of the season of 1926, to another location about three-quarters of a mile northeast of the 1925 location in a field which in 1925 produced 300 sacks of onions to the acre. In

POTATO FIELD UNDER OBSERVATION, KING ISLAND, 1926.
Automatic water gage shown in foreground is set to record the depth on the metal weir of the water entering the field.

PLATE 48.

CORN TANKS, KING ISLAND, 1926.

PLATE 49.

resetting the tanks they were aligned in a general north and south direction, in two groups of eight tanks each. Corn was planted in the north group and potatoes in the south group. The ground immediately adjacent to each group was planted to the same crop as that in the tanks. These tanks are referred to as standard tanks.

In addition to the sixteen tanks carried over from 1925, twelve old tanks, slightly smaller but of the same general design, were found available at the experiment station at Davis. These were remodeled and repaired and brought to King Island and placed in line with the standard tanks. They were used in an experiment to determine the possibility of potatoes growing and maturing without irrigation and with various initial soil moisture conditions. These tanks are referred to as the smaller tanks.

The tanks containing corn used water at a rate considerably in excess of that which was anticipated, amounting as a maximum to about six quarts in a day from a single tank containing a single hill of corn. The season's use per unit of area, according to preliminary figures, is about 50 per cent in excess of that found in the 33.11-acre field.

The results of irrigation of potatoes in tanks in 1926 indicate a use of water equal to about 60 per cent of that in uncovered tanks in 1925. The total weight of dry tops and the total weight of dry matter produced in 1926 were each equal to about one-fourth of the corresponding amounts in 1925. The mean use of water in 1926 is only a little more than 50 per cent in excess of that which can probably be accounted for by evaporation from the soil surface.

The potatoes from the tanks in 1926 were again attacked by nematodes. They were harvested, however, before the process of destruction of the tubers had advanced very far.

The yield of potatoes and tops from the smaller tanks was also small, but there was relatively little invasion by nematodes. The analysis relating to these tanks has not yet been made.

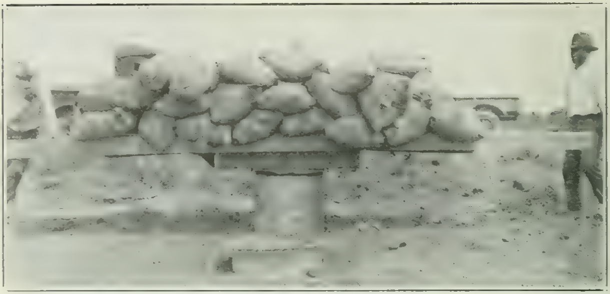
SEDIMENTARY LANDS—1926.

Investigation to determine the consumptive use of water in the lower unit of Reclamation District No. 999 was continued through the season of 1926. The nature and volume of the data collected are such that time beyond this writing will be required for the presentation of analysis and results.

Additional ratings of the 60-inch steel siphon at Plant No. 10 have been made to cover the periods of partial vacuum which were noted in the report for 1925. Remodeled pumps and those newly installed have been rated. The considerable area of water surface in the tract has been investigated and will be taken into account in calculations of irrigation duty. Ratings and records have been made which will serve for the computation of the use of water on a single field of potatoes, one of beans, and an orchard. Some data have been accumulated which seem to have a bearing on the question of seepage. A complete survey has been made for a crop map of the tract. The observation and record of ground water elevations have been maintained throughout the season.

Tank Work in Reclamation District No. 999.

The twelve standard tanks which were used at Medford Island in 1925 were brought to Reclamation District No. 999 at the opening of



PLACING TANKS, RECLAMATION DISTRICT 999, 1926.

Inner cylinder of tank part way down in sedimentary soil. Compare with Plate 39 and note much greater weight required than in peat.

PLATE 50.

UNDISTURBED SOIL IN PLACING TANKS,
RECLAMATION DISTRICT 999, 1926.

Inner cylinder of tank, containing soil, has been hoisted after sinking. The bottom, shown in foreground, will be attached.

PLATE 51.

the season of 1926. They were placed in two rows running north and south, on the north side of Tule Road. The east row is on the land of I. H. Smith, in a potato field, and was planted to potatoes. The west row is on the land of R. E. Webber in a bean field, and was planted to beans. Plates 50 and 51 are photographs showing the tank installation.

Potato tank No. 5 refused early in the season and thereafter to take water from the annular space. Its yield of potatoes was half of the average yield of the other five tanks.

The use of water per tank in the five tanks excluding No. 5 was more than twice as much as in the standard potato tanks at King Island in 1926, and about 30 per cent more than for the uncovered potato tanks at King Island in 1925.

The average yield of potatoes per tank, excluding No. 5, was seven times as great as at King Island in 1926 and 70 per cent in excess of the average yield from uncovered tanks at King Island in 1925. The total yield of the six tanks, in proportion to the area of the soil surface in the tanks, was at the rate of 29,000 pounds per acre.

The six bean tanks yielded a total of 562.55 grams of beans, corresponding to 3100 pounds per acre of soil surface in the tanks, and used a mean of a little more than half as much water per tank as was used by the potato tanks, exclusive of No. 5.

OBJECTIVE AND DIFFICULTIES.

As has been stated a number of times in connection with this investigation, its primary and direct objective is to determine the consumptive use of water in the Sacramento-San Joaquin Delta. This is interpreted to mean the determination of the consumptive use by crops in the best condition of health practically attainable, growing in a soil conditioned to the highest practicable degree for that crop. Determinations made otherwise are of greatly diminished value, and at the best are no more than approximations to or indications of the factors desired to be evaluated. Consequently it becomes necessary for the investigators to devote a portion of the time and funds available to securing the favorable conditions which are imperative. Some of the circumstances of the investigations on the peat lands, as appears in the foregoing paragraphs, have been particularly harmful in the direction of vitiating results, and it is a part of the plan for next season to undertake to eliminate from the province of the tank work, at least, the most serious of these.

SEEPAGE.

The problem of the water supply made available to crops in the delta by means of seepage is one which, as the investigations progress, presents itself more and more insistently as demanding solution. In the first report on the work, in 1924, it was assumed that the seepage supply reached the fields by a lateral or horizontal movement in the soil and subsoil after passing under the levees from the surrounding channels. Now evidence seems to be accumulating to show that a lateral or horizontal movement takes place under pressure at considerable depths beneath the ground surface, and that in such case the immediate approach of the water to the zone of root growth of crops is vertically upward through a less permeable formation overlying that in which the horizontal movement is effected. Where such conditions exist, it is manifestly important that they should be known, and that the source of the seepage water should be ascertained. If the source is found to be the rivers, then the seepage water used by crops is to be reckoned as a demand upon the supplying capacity of the rivers.

The investigation is already confronted with the variation in the amounts of water used in irrigation, which apparently are due chiefly to variations in seepage conditions. The location of the source of the seepage water may serve to explain these.

Alkali and drainage questions may involve both the source and the route of the seepage water. A demonstration on these points may result in change in the method and plan of drainage.

It is not known that methods have been developed and are already at hand to be used to solve these problems. It is probable that training in various scientific lines must be brought to bear on them in order to obtain satisfactory or complete solutions. In the meantime, attention is given to securing pertinent facts, and making such advance upon the problem as may be possible.

PERSONNEL.

Mr. Lloyd N. Brown has been in resident charge of the investigations on peat lands during the three seasons that they have been in progress, and Mr. Frank Davis has served in the same capacity on the sedimentary lands in 1925 and 1926. Whatever of merit attaches to the work is largely due to the training, industry and initiative which these men have brought to it.

APPENDIX D.

REPORT ON COOPERATIVE STREAM FLOW MEASUREMENT WORK.

By H. D. McGlashan, District Engineer, United States Geological Survey.

Stream measurements in California were first undertaken by the State of California in 1870 under the direction of William Ham Hall, state engineer. The office of state engineer was discontinued, however, in 1884 and practically no further stream studies were made until 1894 when the United States Geological Survey undertook the work. Cooperation in stream measurements between the United States Geological Survey and the State of California was first provided for by the state legislature in an act approved March 16, 1903, which empowered the State Board of Examiners to enter contracts "for the purpose of gaging streams." Similar acts were aproved on March 20, 1905, and on March 11, 1907, except that the latter named the Department of Engineering as the cooperating party. On April 22, 1909, the work was placed on a permanent basis by the approval of an act which provided for a continuing appropriation for cooperation between the Department of Engineering and the United States Geological Survey. In 1916, the State Water Commission (now Division of Water Rights) became also a cooperating party. The amounts expended for this cooperative work in California since 1909 are shown in Table 24.

TABLE 24.

Expenditures for Cooperative Water Resources Investigations in California Through the Water Resources Branch of the United States Geological Survey.

Fiscal year	Federal[1]	State		Miscellaneous	Estimated cost of data furnished	Total
		Division of Water Rights	Other bureaus			
1909			$8,500 72			
1910	$4,432 52		8,940 33			
1911	5,609 76		9,355 32			
1912	4,621 62		20,866 51			
1913	4,999 30		27,185 67			
1914	4,635 97		18,606 55	$804 60		
1915	7,173 88		10,382 14	4,162 43		
1916	4,356 10	$3,623 79	8,999 97	4,126 97		
1917	7,217 40	6,867 52	8,999 88	4,380 29	$15,536 66	$43,001 75
1918	4,871 97	7,157 56	9,069 90	2,454 58	10,191 05	33,745 06
1919	6,480 99	8,569 34	7,191 70	9,125 42	6,740 00	38,107 45
1920	9,153 18	9,394 26	8,555 01	8,052 05	6,405 00	41,559 50
1921	13,709 27	4,777 31	7,637 21	8,561 62	7,210 00	41,895 41
1922	8,925 26	9,729 63	12,185 53	149,468 00	7,250 00	187,558 42
1923	9,961 36	10,603 75	12,602 45	163,804 89	5,660 00	202,632 45
1924	7,678 91	9,999 58	12,583 01	124,912 55	9,832 00	165,006 05
1925	9,962 78	10,000 42	11,534 84	83,447 65	8,010 00	122,955 69
1926	13,345 84	7,879 52	15,167 00	145,870 07	7,779 00	190,041 43
Totals	$127,136 11	$88,602 68	$218,363 74	$709,171 12	$84,613 71	$1,066,503 21

[1] Does not include federal funds for ground water investigations and other federal expenditures through the Washington office.

The cooperative investigation during the fiscal years 1925 and 1926 was maintained without material change over the previous biennium.

The net gain in number of river-measurement stations maintained was seven. There was no change in the regular cooperative funds during this period, but there were slight changes in miscellaneous cooperation. The special investigation maintained for the Federal Power Commission, in cooperation with permittees and licensees, shows a steady increase and results in a large amount of very valuable stream-flow data available to the public.

The 236 river-measurement stations maintained during the two-year period ending June 30, 1926, are distributed among the major drainage basins of the state as follows: Sacramento 28 per cent, San Joaquin 39 per cent, South Pacific 26 per cent, North Pacific 4 per cent, and Great Basin 3 per cent. This number does not include stations maintained by private parties, for which complete records are made available for publication in the annual progress reports of the Geological Survey.

This surface water investigation has been maintained in accordance with cooperative agreements with the State of California, through the Divisions of Engineering and Irrigation and of Water Rights, Department of Public Works; the city of Sacramento, through Albert Givan, general manager and chief engineer of the Sacramento Municipal Utility District; the city of Stockton, through W. B. Hogan, city engineer; the city and county of San Francisco, through M. M. O'Shaughnessy, city engineer; Los Angeles County, through the board of supervisors; the city of Los Angeles, through the department of public works; San Bernardino, Riverside, and Orange counties, through the boards of supervisors; United States Forest Service; United States Weather Bureau; United States Indian Service; and National Park Service. In addition, the following public service companies have furnished substantial cooperation: Pacific Gas and Electric Company, Spring Valley Water Company, San Joaquin Light and Power Corporation, Southern California Edison Company, Southern Sierras Power Company, Snow Mountain Water and Power Company, and Western States Gas and Electric Company. Also, valuable assistance has been furnished by a number of irrigation districts, private companies, and individuals.

The amount of work done and its cost, including estimated expenditures for complete records of stream flow furnished for publication, for the biennium ending June 30, 1926, are shown in Table 25.

The following Water-Supply Papers, containing data for California, have been published since the last biennial report of the Division of Water Rights.

No. 519, Ground Water in Santa Clara Valley, California.
No. 531, Surface Water Supply of Pacific Slope Basins in California, 1921.

Water-Supply Papers 530, for 1921; 550 and 551, for 1922; 570 and 571, for 1923; 590 and 591, for 1924; and 610 and 611, for 1925, are in process of publication. All California records of stream flow included in these unpublished reports, and many records for 1926, are now compiled and are available upon application to the office of the Geological Survey in San Francisco.

TABLE 25.

Summary of River Measurement Work and Expenditures, July 1, 1924, to June 30, 1926.

Drainage basin	Number of stations			Number of discharge measurements			Cost			Average cost per station of 12 months record including new construction, top cost, and office work
	Established	Discontinued	Maintained June 30, 1926	At regular stations	Miscellaneous	Total	Operation and maintenance	New construction	Office work, top cost, and non-expendable property	
Sacramento	16	3	75	1,222	115	1,337	$33,390 46	$10,315 46	$13,864 07	$429 42
San Joaquin	16	5	90	2,424	282	2,706	116,655 56	28,547 63	14,469 83	1,103 68
South Pacific	5	2	62	3,527	455	3,982	29,700 28	1,349 26	21,329 51	434 85
North Pacific	0	2	8	50	7	57	1,845 16	0	811 78	153 06
Great Basin	0	1	12	82	0	82	2,837 96	0	660 64	140 30
Totals or average			247	7,305	859	8,164	$214,429 42	$40,212 35	$51,138 83	$651 28

In the administration of the work of the Water Resources Branch of the Geological Survey, the district office is maintained at 303 Customhouse, San Francisco. In November, 1925, the distribution office and the official library were consolidated with the district office. A supply of all Geological Survey publications, available for free distribution, is kept in stock and may be obtained at the office or requested by mail. The library, maintained for the use of the public, contains a complete set of Geological Survey maps, covering all sections of the United States, and a complete file of Water-Supply Papers, Bulletins, Professional Papers, Monographs, Mineral Resources Reports, Geologic Folios, and other Geological Survey reports. Also there are many maps and special reports relating to the natural resources of the United States, especially of the western states.

A suboffice is maintained at 600 Federal Building, Los Angeles, for the convenience of southern California and as a headquarters for work in the South Pacific drainage. An office library of Geological Survey publications is maintained for the use of the public, and publications are distributed.

The water resources investigation in California is under the supervision of Mr. N. C. Grover, chief hydraulic engineer, and Mr. John C. Hoyt, hydraulic engineer in charge of surface waters for the Geological Survey.

APPENDIX E

IMPORTANT APPLICATIONS AND PERMITS FOR THE BIENNIAL PERIOD

TABLE 26.

Important Proposed Irrigation Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1926.

NOTE—All projects of 500 acres or more are listed by name. Projects of less than 500 acres, including domestic and industrial applications, are shown as a single group at the end of the table. Cancelled filings are not included.

Name of applicant	Application number	County	Source of supply	Amount of water		Acres to be irrigated	Estimated cost
				Natural flow, second-feet	Storage, acre-feet		
City of Sacramento	4182	El Dorado	Silver Creek and Silver Fork of American River	400.00	210,000	20,000	
Guy T. Stetson et al., trustees for proposed Ojai Irrigation District	4184	Ventura	Matilija Creek	--	7,500	15,000	$800,000
San Gabriel River Water Committee	4197	Los Angeles	San Gabriel River		30,000	15,000	--
Ramona Irrigation District	4202	San Diego	Hatfield Creek		3,500	10,000	250,000
Ramona Irrigation District	4203	San Diego	Santa Ysabel Creek		5,000		50,000
Lindsay-Strathmore Irrigation District	4205	Tulare	St. Johns Branch Kaweah River		25,000	15,259	30,000
La Mesa, Lemon Grove and Spring Valley Irrigation District	4208	San Diego	San Diego River	10.00	3,000	14,225	50,000
Potter Valley Irrigation District	4210	Lake, Mendocino	South Eel River	10.00	12,500	5,000	10,000,000
Holland Land Company, William Timson and Walter J. Seaborn	4218	Yolo	West Cut of Reclamation District No. 900	35.00	--	2,800	10,000
Glendora Consolidated Mutual Irrigation Company	4223	Los Angeles	Big Dalton and Little Dalton Canyons	28.50		2,280	
Patterson Ranch Company	4237	Stanislaus	San Joaquin River	27.36	--	2,180	35,000
H. O. Harrison	4263	Tehama	Old Gazelle Channel of Sacramento River	6.54	--	523	25,000
Mrs. Annie Fabian, F. Tocklas and A. Grunauer	4275	San Joaquin	Old River	17.50	--	1,122	15,000
A. and M. Grunauer and Louis Krohner	4276	San Joaquin	Old River	29.87	--	2,515	25,000
Willard Smith, L. W. Evans and C. R. Browning	4302	Orange	Santiago Creek and tributaries		20,000	6,000	500,000
Newhall Land and Farming Company	4358	Los Angeles	San Francisquito Creek	45.62		3,650	
W. S. Kendall	4364	Yolo	Sacramento River	7.25		582	8,000
North Sacramento Land Company	4385	Sacramento	American River	8.00	--	800	15,000
John Ohm	4399	San Joaquin	San Joaquin River	13.19	--	1,055	14,000
J. J. Fleming	4412	Lassen	Secret Valley Creek and tributaries		4,500	2,030	6,600
M. J. Lund	4432	San Joaquin	Old River and Grant Line Canal	16.13		1,200	9,000
Harry Lee Martin, A. W. Goodfellow, H. L. Heffner, trustees for proposed water storage district	4439	Kings	Kings River	2,494.41	280,000	199,553	--
Harry Lee Martin, A. W. Goodfellow, H. L. Heffner, trustees for proposed water storage district	4440	Kings	Kings River	2,494.41	120,000		
L. A., Mary A., E. L., and F. C. Bixler	4452	San Joaquin	Middle River and Grant Line Canal	32.15		2,572	63,000
River Junction Reclamation District No. 2064	4460	San Joaquin	Stanislaus River	72.30		5,783	7,500
Lewis Moreing	4470	San Joaquin	Paradise Cut	14.14		1,131	34,000
Moreing Brothers	4471	San Joaquin	San Joaquin River	7.83		627	14,000
Charles Moreing	4507	San Joaquin	San Joaquin River	9.17		734	23,000
William, William C. and Alfred Ferguson	4513	San Joaquin	Grant Line Canal	12.72		1,017	16,000
Santa Maria Irrigation District	4515	San Luis Obispo, Santa Barbara	Cuyama River	60.00	72,000	31,000	1,408,481
Little Rock Midland Irrigation District	4574	Los Angeles	Little Rock Creek	50.00	5,000	2,400	--

Glendora Consolidated Mutual Irrigation Company	4582	Los Angeles	Los Angeles River	10 00	5,000	2,280	75,000
Glendora Consolidated Mutual Irrigation Company	4583	Los Angeles	San Gabriel River	10 00	5,000		
Paul N. Nunn et al., trustees for Deep Springs, an educational institution	4584	Inyo	Deep Springs	10 00	1,000	1,560	15,000
H. M. Byllesby and Company	4600	Butte	Feather River	500 00		50,000	750,000
Guy T. Stetson et al., trustees for proposed Ojai Irrigation District	4615	Ventura	Sespe Creek		30,800	15,000	1,750,000
Union Sugar Company	4628	Santa Barbara	San Antonio Creek	10 54		843	3,000
Alfred S. and William C. Ferguson	4635	Contra Costa	Old River and Western Canal	12 21		977	11,000
Caroline Moran	4637	San Joaquin	Middle River	12 44		995	9,000
E. L. Adams	4663	Butte	Hamlin Slough	22 50		1,215	400
Gorrill and Hotchkiss	4664	Butte	Hamlin Slough	22 50		2,338	250
Gorrill and Hotchkiss	4665	Butte	Butte Creek	15 00			
Ventura Power Company	4676	Ventura, Los Angeles	Piru Creek	200 00	75,000		
Ventura Power Company	4677	Ventura, Los Angeles	Sespe Creek	200 00	111,800		
Dry Creek Irrigation District	4681	Yuba	Dry Creek		13,798	1,000	
B. C. Rogers	4715	Yolo, Solano	Putah, Eticuera, Pope and Capell Creeks	1,500 00	340,000	120,000	1,950,000
Carmichael Irrigation District	4743	Sacramento	American River	10 00		1,800	120,000
California Land Finance Company	4766	San Joaquin	14 Mile Slough	21 20		1,702	33,600
D. Fricot	4769	Calaveras	San Antonio Creek		500	550	10,000
Water Conservation Association	4807	San Bernardino	Santa Ana River and its tributaries		250,000	52,640	
Peninsula Farms Company	4848	San Mateo	Butano Creek	2 67		880	30,000
T. L. Quigley	4862	Butte	Lateral "A," Drainage Canal, Reclamation District No. 833	20 00		892	5,000
C. M. Faris Estate	4887	Butte	Lateral "A," Drainage Canal, Reclamation District No. 833	13 27		591	2,000
W. F. Detert	4889	Lake	Bucksnort Creek	6 25	600	1,002	100,000
Matie S. Vail	4894	San Joaquin	Beaver Slough	8 10		651	32,500
E. O. Morse	4896	Sacramento	Burton Slough, Mokelumne River and Burton Cut	11 56		925	
Henry D. and E. C. Gage	4898	Butte	Cherokee Slough	8 00		709	
Frank L. Fisher	4901	Yolo	Sacramento River	22 00		990	5,500
Frank L. Fisher	4902	Yolo	Sacramento River	8 12		650	900
Montague Irrigation District	4912	Siskiyou	Little Shasta River	50 00		17,150	300
Yuba River Power Company	4916	Yuba	North Fork Yuba River		15,000		
La Mesa, Lemon Grove and Spring Valley Irrigation District	4929	San Diego	Santa Ysabel Creek	50 00	18,000	12,000	
Leo M. Harvey and Louis Evans	4941	Marin	Olema Creek and Bear Valley Creek	3 00		760	30,000
Rindge Land Reclamation District No. 2036	4942	San Joaquin, Contra Costa	Old River, Rock Slough, Indian Slough	30 80		2,465	
Rindge Land Reclamation District No. 2037	4943	San Joaquin	San Joaquin River, Disappointment Slough, 21 Mile Slough, 14 Mile Slough	85 45		6,837	
Rindge Land Reclamation District No. 2038	4944	San Joaquin	Empire Cut, Whiskey Slough, Middle River	71 74		5,739	
Rindge Land Reclamation District No. 2039	4945	San Joaquin	Trapper's Slough and Middle River	78 60		6,289	
Herbert W. Barmann	4951	Butte	Canal of Drainage District No. 100	10 00		1,293	1,000
Manly S. Harris	4959	Butte	Hamilton Slough and Lateral C, Reclamation District No. 833	15 00		2,529	10,000
E. A. Julian	4962	Lassen	Long Valley Creek		17,000	2,881	216,000
S. D. Balch	4974	Santa Clara	Casey Gulch Creek	1 00		505	
Red Rock Creek Irrigation District	4980	Lassen	Red Rock Creek		16,500	2,260	76,800
Red Rock Creek Irrigation District	4981	Lassen	Cold Springs Creek		8,100		
Ralph Bennett	4982	Los Angeles	Big Rock and Pallett Creeks		5,000	5,000	
Guy T. Stetson et al., trustees for proposed Ojai Irrigation District	4986	Ventura	North Fork Matilija Creek	100 00		15,000	30,000

TABLE 26—Continued.

Important Proposed Irrigation Projects as indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1926.

NOTE—All projects of 500 acres or more are listed by name. Projects of less than 500 acres, including domestic and industrial applications, are shown as a single group at the end of the table. Cancelled filings are not included.

Name of applicant	Application number	County	Source of supply	Amount of water		Acres to be irrigated	Estimated cost
				Natural flow, second-feet	Storage, acre-feet		
Gregory M. Creutz	4988	Ventura	Branch of Little Sycamore Canyon	2.50	200	640	
Pescadero Reclamation District No. 2058	4991	San Joaquin	Tom Paine Slough and Paradise Cut	100.00		8,350	
John C. Droge	5007	Stanislaus	San Joaquin River	10.00		800	
W. A. Pack	5032	San Benito	Arroyo de los Picachos Creek		2,000	1,000	
Samuel W. Swan and Carl A. Davis	5042	San Diego	San Felipe Creek	2.50	33,000	20,000	500,000
Mrs. Louisa Stark	5047	San Joaquin	Salmon Slough and Middle River	16.68		1,335	10,000
Edna Gianelli, Cora B. Lamb and Henry Riley	5092	San Joaquin	Beaver Slough and South Fork of Mokelumne River	15.15		1,212	15,000
Nevada Irrigation District	5103	Nevada, Placer	Bear River		125,000	125,000	
James D. and Mary Louise Phelan	5109	Butte	Philbrook and Butte Creeks		3,000	2,080	
Parrott Investment Company	5110	Butte	Philbrook Creek		3,000	14,471	50,000
Big Creek Ranch, Incorporated	5129	Trinity	Big Creek		40,000	22,000	200,000
James A. Hubbard and W. C. Blagrave	5141	Shasta	Clear Creek	125.00	9,600	19,200	380,000
State Land Settlement Board	5143	Butte	Sacramento River	20.00		3,450	
G. R. Holcomb Estate Company	5144	Sierra	Little Truckee River		28,000	6,000	150,000
Maude C. Maddrill	5145	Butte	Clear Creek	15.00	4,000	1,042	
Felton Water Company	5148	Santa Cruz	Limestone Brook	.26		700	10,000
Theodor Lorenzen	5153	San Joaquin	San Joaquin River	12.34		988	16,000
Island Reclamation District No. 2062	5155	San Joaquin	San Joaquin, Old River and Paradise Cut	50.00		3,938	
City of San Jose	5156	Santa Clara	North Fork Penitencia Creek		500	600	
C. S. Wheeler	5169	Nevada	Little Truckee River		49,000	25,000	500,000
Thomas O. Williams	5179	San Bernardino	Mojave River	25.00		2,000	30,000
Islam Redwoods Shrine	5180	San Mateo	Pescadero Creek		500	1,640	25,000
W. C. Stevens	5181	Butte	Butte Creek		2,000	1,740	
509 smaller projects				**451.88**	**15,986**	**30,850**	**1,420,000**

TABLE 27.

Important Proposed Power Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1926.

NOTE—All projects of 500 theoretical horsepower or more are listed by name. Projects of less than 500 theoretical horsepower are shown as a single group at the end of the table. Cancelled filings are not included.

Name of applicant	Application number	County	Source of supply	Amount of water		Theoretical horsepower to be developed	Estimated cost
				Natural flow, second-feet	Storage, acre-feet		
Nevada Irrigation District	4309	Nevada	South Fork of Yuba River	135 00		59,150	
Nevada Irrigation District	4310	Nevada	South Fork of Yuba River	126 00		16,852	
Appleton Land, Water and Power Company	4426	San Bernardino	Deep Creek	130 00		2,000	$400,000
Red River Lumber Company	4436	Shasta	Hat Creek	190 00		13,818	500,000
Feather River Power Company	4441	Plumas	Bucks Creek		78,000	106,949	9,000,000
Feather River Power Company	4453	Plumas	Milk Ranch Creek and three tributaries	35 00	1,000	12,998	
O. E. Freeman, J. H. Knapp and Charles A. Giffen	4184	Trinity	North Fork and East Fork of North Fork of Trinity River	450 00	170,000	75,277	6,000,000
Feather River Power Company	4491	Plumas	Bucks Creek and Grizzly Creek	175 00		62,759	(See 4441)
Nevada California Power Company	4548	Inyo	Green Lake Creek		2,000	9,733	
Southern Sierras Power Company	4549	Inyo	Green Lake Creek		2,000	2,281	
San Joaquin Light and Power Corporation	4573	Tulare	Wilson and Morehouse Creek Springs	6 00		1,057	11,500
P. B. Cross	4575	Tehama	Deer Creek	150 00		18,629	1,669,648
Feather River Power Company	4598	Plumas	Grizzly Creek	105 00		29,627	(See 4441)
Feather River Power Company	4599	Plumas	Milk Ranch Creek and three tributaries	40 00		14,854	
James B. Knight, Fred M. Kay, J. L. Stone, W. H. Haw, Frank Breeden, and David Wilson	4630	Trinity	New River	62 50		5,433	110,000
Joshua N. Turner, assigned to W. L. Leland	4673	Plumas	Jamison, Bear, Deer and Downieville Creeks	30 00	6,400	6,011	100,000
Ventura Power Company	4674	Ventura	Sespe Creek	200 00	101,000	37,800	
Ventura Power Company	4675	Ventura, Los Angeles	Piru Creek	200 00	75,000	37,750	
Western States Gas and Electric Company	4686	El Dorado	Silver Fork of American River		7,500	27,982	
El Dorado Power Company	4687	El Dorado	Silver Fork of American River		7,500	122,564	
H. M. Byllesby and Company	4689	Plumas	Middle Fork Feather River		80,000	115,199	1,250,000
San Joaquin Light and Power Corporation	4703	Fresno	North Fork King's River	220 00		141,750	32,300,000
San Joaquin Light and Power Corporation	4704	Fresno	North Fork King's River	330 00		60,750	10,000,000
San Joaquin Light and Power Corporation	4705	Fresno	North Fork King's River		86,000	60,750	
Stephen E. Kieffer	4737	Amador	Mokelumne River	200 00		5,000	
R. B. Swayne and J. N. Turner	4750	Plumas	Jamison Creek	10 00		6,000	100,000
East Bay Municipal Utility District	4768	Amador, Calaveras	Mokelumne River	375 00	217,000	13,849	6,000,000
Snow Mountain Water and Power Company	4788	Lake, Mendocino	South Eel River	400 00	214,813	21,681	6,954,910
Red River Lumber Company	4824	Shasta	Hat Creek	10 00		676	630,000
Oroville Wyandotte Irrigation District	4834	Plumas, Butte	South Fork Feather River, Lost Creek, Dry Creek, Little Grass Valley Creek, New York Flat Creek	415 00	199,792	66,647	4,000,000

TABLE 27—Continued.

Important Proposed Power Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1926.

NOTE.—All projects of 500 theoretical horsepower or more are listed by name. Projects of less than 500 theoretical horsepower are shown as a single group at the end of the table. Cancelled filings are not included.

Name of applicant	Application number	County	Source of supply	Amount of water		Theoretical horsepower to be developed	Estimated cost
				Natural flow, second-feet	Storage, acre-feet		
Charles F. Bradford	4843	El Dorado	North Fork Cosumnes River	75.00	20,000	12,784	
Charles F. Bradford	4844	Amador, El Dorado	Middle Fork Cosumnes River, Sopiago Creek, South Fork of South Fork of Cosumnes River		30,000	6,818	
Charles F. Bradford	4845	El Dorado	Middle Fork Cosumnes River	130.00	36,500	9,955	
Charles F. Bradford	4846	El Dorado	North Fork Cosumnes River	100.00	20,000	5,900	
Feather River Power Company	4869	Plumas	Pebble Creek and (3) unnamed branches of Milk Ranch Creek	5.00		1,450	$7,700,000
Feather River Power Company	4870	Plumas	Branch of Bucks Creek, Bear Trap Creek, Slide Creek, Forked Ravine and Bear Ravine	17.00		2,030	
Feather River Power Company	4871	Plumas	Grizzly Creek	20.00		5,800	
Guy T. Stetson et al., trustees for proposed Ojai Irrigation District	4975	Ventura	Sespe Creek	----	30,800	6,818	2,060,000
Sierra and San Francisco Power Company	4999	Tuolumne	Herring Creek	----	9,000	30,665	100,000
East Bay Municipal Utility District	5002	Amador, Calaveras	Mokelumne River	750.00	25,000	12,630	800,000
Pacific Gas and Electric Company	5004	Yuba	North Fork Yuba River		15,000	7,955	
Stephen E. Kieffer	5056	Amador	Mokelumne River	300.00	----	9,370	1,500,000
Nevada California Power Company	5068	Mono	Leevining Creek	30.00	----	20,058	1,170,022
Turlock Irrigation District	5094	Tuolumne	Tuolumne River and Moccasin Creek	1,200.00	20,000	27,000	5,574,000
P. B. Crum	5116	Tehama	Deer Creek	200.00	25,000	108,500	
East Bay Municipal Utility District	5128	Amador, Calaveras	Mokelumne River	375.00	100,000	13,849	6,150,000
Yosemite Power Company	5131	Tuolumne	South and Middle Forks Tuolumne River	175.00	65,000	66,303	5,500,000
Pacific Gas and Electric Company	5161	Alpine	Deer Creek		9,412	14,170	600,000
C. S. Wheeler	5170	Nevada	Truckee River	500.00		11,023	
34 smaller projects				**140.00**	**1,064**	**2,840**	**110,500**

TABLE 28.

Important Proposed Mining Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1926.

NOTE—All projects of 10 second-feet or more are listed by name. Projects of less than 10 second-feet are shown as a single group at the end of the table. Cancelled applications are not included

Name of applicant	Application number	County	Source of supply	Amount of water		Estimated cost
				Natural flow, second-feet	Storage, acre-feet	
Gus. Perigot	4241	Trinity	New River	125.00		$75,000
G. C. Williams	4624	Siskiyou	Oak Flat Creek	20.00		
James B. Knight, Fred M. Kay, J. L. Stone, W. H. Haw, Frank Breeden and David Wilson	4631	Trinity	New River	62.50		55,000
C. L. and J. M. Huestis	4732	Siskiyou	Dry Lake Creek	25.00		1,000
W. B. Owens and D. E. Owens	4757	Siskiyou	Goodyear Creek	10.00		1,000
James Wilson Martin	4833	Sierra	Hungry Mouth Ravine	25.00		1,000
A. Humphreys	4885	Sierra	South Fork of North Fork of Yuba River	40.00		10,000
G. W. Peer	4932	Inyo	Springs in Addie Canyon	10.00		
Charles F. Willard	5019	Trinity	North Fork Trinity River	25.00		30,000
L. B. Rouse	5115	Calaveras	Middle Fork Mokelumne River	12.00		500
61 smaller projects				**69.80**	**1,600**	**343,700**

TABLE 29.

Proposed Municipal Projects as Indicated by Applications to Appropriate Water Filed During the Biennial Period Ending September 1, 1926.

NOTE—Cancelled applications not included.

Name of applicant	Application number	County	Source of supply	Amount of water		Population of area to be served	Estimated cost
				Natural flow, second-feet	Storage, acre-feet		
City of Los Angeles	4220	Los Angeles	San Francisquito Creek	400.00	38,168		$1,250,000
East Bay Municipal Utility District	4228	Amador, Calaveras	Mokelumne River	310.00	217,000	2,500,000	80,000,000
North Sacramento Light and Water Company	4386	Sacramento	American River	12.40		27,000	25,000
City of Los Angeles	4434	Inyo	Scotty Springs	1.00			
City of Pasadena	4447	Los Angeles	San Gabriel River	80.00		210,000	7,000,000
City of Pasadena	4448	Los Angeles	San Gabriel River		19,000		10,300,000
City of Alhambra	4534	Los Angeles	San Gabriel River	25.00		30,000	25,000,000
City of Alhambra	4547	Los Angeles	San Gabriel River		30,000		
McCloud River Lumber Company	4561	Siskiyou	McCloud River	5.57		3,000	75,000
Central Mendocino County Power Company	4572	Mendocino	James Creek	2.00	635	12,500	40,000
City of Long Beach	4590	Los Angeles	San Gabriel River	155.00	112,000	1,000,000	
City of Whittier	4604	Los Angeles	San Gabriel River	20.00	31,500	64,000	4,000,000
City of Alhambra	4695	Los Angeles	San Gabriel River		30,000	30,000	
City of Alhambra	4706	Los Angeles	San Gabriel River		30,000		
Palm Valley Water Company	4751	Riverside	Chino Creek		900	12,000	2,500
Palm Valley Water Company	4752	Riverside	Falls Creek and Snow Creek	5.00			81,000
City of Compton	4860	Los Angeles	San Gabriel River		10,950	30,000	1,500,000
Bolinas Public Utility District	4881	Marin	Arroyo Hondo Creek	1.00		1,500	50,000
El Dorado Irrigation District	4888	El Dorado	Stonebreaker Creek		2,900	2,000	
			Diamond Creek		1,900		
Montague Irrigation District	4909	Siskiyou	Little Shasta River	2.30		2,000	8,000
City of Eureka	4971	Humboldt	Jacoby Creek		4,400	20,000	500,000
City of San Diego	4997	Riverside, Imperial	Colorado River	135.00		142,000	
Felton Water Company	5020	Santa Cruz	Limestone Brook	.12		1,000	5,000
City of Stockton	5025	Amador, Calaveras	Mokelumne River	60.00	30,000	240,000	
City of Monrovia	5083	Los Angeles	Sawpit and Monrovia Canyons	10.00			1,000
Felton Water Company	5194	Santa Cruz	Limestone Brook	.26		1,000	10,000

TABLE 30.

Important Permits Issued for Agricultural Purposes During Biennial Period Ending September 1, 1926.

NOTE—All projects of 100 acres or more are listed by name. Projects of less than 100 acres, including permits for domestic, stock and industrial uses are shown as a single group at the end of the table. Cancelled filings are not included.

Name of permittee	Permit number	Application number	County	Source of supply	Acres irrigated	Second-feet granted	Acre-feet granted	Estimated cost
John Wisnom	1816	4102	Stanislaus	San Joaquin River	200	2.50		$10,000
R. N. Blossom	1819	3990	San Joaquin	Mokelumne River	978	12.00		7,500
Thomas Gallagher	1820	3083	Los Angeles	Indian Springs and Cienega	120	.01	50	1,500
Walts Brothers	1822	2508	Sierra	Dog Valley Watershed	2,000		8,000	138,575
Mrs. C. H. Ewers and Margaret Mooney	1829	3619	Tehama	Wells	445	8.00		12,000
The McCormack-Williamson Company	1830	3914	Sacramento	Mokelumne River, Snodgrass Slough	1,590	19.80		2,000
San Lucas RanchCompany, Frank G. Walker, Owner	1831	4007	Santa Barbara	Well, Santa Ynez River	204	3.00		20,000
D. L. Jungck	1847	3995	Nevada	Boulder Brook (Ragsdale Ravine)	200		40	1,500
Herbert F. Nelles	1858	3253	Riverside	Cottonwood Canyon	320	.25		5,000
E. L. Adams and Herbert W. Whitten	1872	2805	Butte	Butte Creek	1,215	14.00		2,000
Fred T. Kirschenman, George and William Preszler	1876	3830	San Joaquin	Mokelumne River	170	2.12		10,000
J. J. Mooney	1882	3499	Tehama	Sacramento River	365	4.56		8,000
Central Commercial and Savings Bank, Vallejo, California	1883	3668	Stanislaus	Amphir Cut	1,482	18.52		10,000
Central Commercial and Savings Bank, Vallejo, California	1884	3669	Stanislaus	Stanislaus River	224	2.69		6,000
Reclamation District No. 108	1885	1589	Colusa	Sacramento River	30,210	255.25		130,000
W. P. Dwyer	1886	1725	Yolo	Borrow Pit of Back Levee of Reclamation District No. 108	1,808	60.00		1,000
A. N. Lewis Estate	1888	1617	Colusa	Sacramento River	1,147	10.00		11,000
Mathews and Webber	1889	3915	Solano	West Levee Borrow Pit, Reclamation District No. 999	185	2.31		2,500
Reclamation District No. 999	1890	4099	Yolo	West Levee Borrow Pit, Reclamation District No. 999	386	4.82		5,795
Reclamation District No. 999	1891	4100	Yolo	Elk Slough	21,905	114.00		15,000
Reclamation District No. 999	1892	4101	Yolo	West Levee Borrow Pit, Reclamation District No. 999	1,038	12.80		9,000
C. W. Clarke Company	1893	2227	Lassen	Coyote Flat Drainage Area	4,360		7,100	10,000
W. C. Frank	1894	3957	San Joaquin	San Joaquin River	235	2.90		10,000
Mrs. A. A. Bradford	1895	3422	Butte	Dry Creek	1,906	47.65		15,000
John S. Tully	1901	4061	Stanislaus	Dry Creek	101	1.26		3,500
George B. Champlin	1905	3494	Tehama	Sacramento River	285	3.56		3,500
C. E. Williams	1907	3192	Sutter	Sutter By-pass East Dredger Cut	201	3.00		3,000
Thermalito Irrigation District and Table Mountain Irrigation District	1911	1739	Butte	Concow Creek	5,136		8,200	115,015
Fred Flowers	1919	4198	Butte	Pine Creek Lagoon	101	1.00		3,000
City Creek Water Company	1922	3947	San Bernardino	East Fork of City Creek	580		5,000	5,000
David G. Saunders	1925	4209	San Joaquin	San Joaquin River	163	2.00		4,500

TABLE 30—Continued.

Important Permits Issued for Agricultural Purposes During Biennial Period Ending September 1, 1926.

NOTE—All projects of 100 acres or more are listed by name. Projects of less than 100 acres, including permits for domestic, stock and industrial uses are shown as a single group at the end of the table. Cancelled filings are not included.

Name of permittee	Permit number	Application number	County	Source of supply	Acres irrigated	Second-feet granted	Acre-feet granted	Estimated cost
Victor, Valdemar, Peter, Boris, Leo, George and Sophia Cherbak, Inna Demens, James A. Anderson and A. K. Toez	1935	3975	San Bernardino	Underground waters	325	2.00		$15,000
Robert W. Campbell	1936	4000	Butte	Cottonwood Creek	200	2.50		100
Dorathea Finck Raab	1949	4071	San Joaquin	Old River	165	2.06		5,000
William L. Hagenbaugh	1954	4038	Los Angeles	Boulder Creek (Bob Creek or Canyon)	350	1.25		10,000
Stuart J. Titlow	1964	3334	Trinity	East and West Fork of Underwood Creek and springs	130	1.12		500
L. J., E. M. Locke, and Tip Anderson	1966	4215	San Joaquin	Mokelumne River	167	2.08		4,000
James Williams, James O. Kafader and E. L. Kafader	1972	3988	Modoc	Liberman Creek	450	5.63	350	2,500
Reclamation District No. 2068	1973	2318	Solano	Haas Slough	13,120	164.00		700,000
Cedar Pines Park Mutual Water Company	1974	4076	San Bernardino	Spring in East Fork Burnt Mill Canyon	160	0.20		1,500
Harry E. Hurlbutt	1977	4327	Humboldt	Van Dusen River	163	2.00		1,000
Alice Hagar Tubbs	1980	3310	Colusa	Sacramento River	1,454	18.18		26,000
Mrs. Sebia Davis	1981	1659	Colusa	Sacramento River	6,262	108.27		46,660
J. K. Brown, Mollie A. Brown and Ellis Jones	1984	4332	Yolo	Sacramento River	100	1.25		1,200
J. W. Mykrantz	1985	3958	San Diego	San Vicente Creek	570	2.00	149	40,000
Union Sugar Company	1990	3812	Santa Barbara	San Antonio Creek	843	10.54		3,000
John, Jennie, George and Margaret Clements and Minnie J. C. Brown	1995	3213	San Joaquin	Mokelumne River	450	5.60		25,000
Luther Hill	2000	1529	Inyo	Sawmill Creek Lake	1,040		322	3,000
H. O. Harrison	2002	4263	Tehama	Old Gazelle Channel	523	6.54		25,000
Samuel J. Nunn	2007	1544	Butte	Butte Creek	965	10.00		8,000
Albina Bonetti	2010	4110	San Joaquin	Old River and North Canal	670	8.37		7,000
Julius Hauser	2024	4226	Yolo	Sacramento River	460	5.75		10,000
Herbert W. Whitten	2027	2909	Butte	Butte Creek	1,531	20.00		3,000
Ysabel L. Young Hewlett	2033	3776	San Joaquin	Calaveras River	125	1.25		7,500
S. L., Diana, Mary G., and Mary E., Cecil, Lillie A. Sachreiter and Wilbur Jensen	2040	1647	Colusa	Sacramento River	880	22.00		10,000
Henry Barkschat	2044	2367	Los Angeles	Springs (7)	230	0.29		8,000
A. P. Barba	2051	4251	Butte	Feather River	240	3.00		
Thomas O'Connor	2066	4257	Yolo	Sacramento River	160	2.00		2,500
Holland Land Company, William Timson and Walter J. Seaborn	2076	4218	Yolo	West cut of Reclamation District No. 999	2,800	35.00		10,000
P. J. Hiatt	2077	3290	Sutter	Sacramento River	1,073	15.45		15,000
Nevada Irrigation District	2082	1270	Nevada	Canyon Creek, Texas Creek, Fall Creek, South Fork Fall Creek, South Fork Yuba River	208,000	500.00	65,000	2,856,460
Nevada Irrigation District	2085	2276	Nevada	Middle Fork Yuba River, Milton Creek, Jackson Creek		400.00	75,000	3,955,160
Nevada Irrigation District	2086	2277	Nevada	South Fork of Middle Fork of Yuba River		250.00	25,000	75,000
Nevada Irrigation District	2088	2373	Nevada	South Wolf Creek		150.00	12,500	1,709,280

Camp Far West Irrigation District	2089	2881	Placer, Yuba	Bear River	4,102		10,000	125,000
Thomas J., John C., and Mary Johnston	2091	4105	Sutter	Feather River	192	2.40		
Manuel Rose	2098	4351	Yolo	Sacramento River	100	1.25		1,000
H. J. Silvius	2099	4349	Yolo	Sacramento River	100	1.25		2,000
Oakdale Irrigation District and South San Joaquin Irrigation District	2104	1081	Calaveras, Tuolumne	Stanislaus River	145,358		76,195	2,000,000
Oakdale Irrigation District and South San Joaquin Irrigation District	2106	3091	Calaveras, Tuolumne	Stanislaus River	145,358		25,704	2,000,000
Bertram W. Jack	2114	3575	San Bernardino	Hog Canyon	160	.20		10,000
Eliza Smith	2117	4355	Sutter	Sacramento River	366	5.57		1,000
George B. Champlin, Asa G. Peake, Roy S. and Lewis L. Godboldt	2135	3500	Butte	Sacramento River	1,310	16.37		26,000
Ralph Moore	2142	4291	Sacramento	Sacramento River	140	1.75		1,000
Mrs. Annie Hack	2143	4292	Sacramento	Sacramento River	200	2.50		2,000
Rose V. Jones	2156	4536	El Dorado	Little Iowa Creek	139		75	4,000
Peter Frey and I. Jewel	2159	3817	Mendocino	Russian River	150	1.87		8,000
Sutter Basin Company	2169	3195	Sutter	Sacramento River	111	1.38		40,000
Sutter Basin Company	2173	3203	Sutter	Sacramento River	150	1.88		5,000
Sutter Basin Company	2174	3205	Sutter	Sacramento River	608	15.21		7,000
Sutter Basin Company	2175	3206	Sutter	Feather River	3,500	87.49		30,000
Sutter Basin Company	2176	3207	Sutter	Feather River	2,127	53.17		20,000
Sutter Basin Company	2177	3208	Sutter	Nelson Slough	726	18.14		3,500
Charles S. Howard Company	2180	4499	Mendocino	Forsythe Creek	357	4.46	300	23,000
Joe Franklin, John Quadros and Joe Quadros	2184	4153	Siskiyou	Bogus Creek	224	2.80		1,000
Raymond Houx	2190	4312	Glenn	Sacramento River	217	5.42		4,500
Annie, Marjorie, Dorothy and Joe E. McVay	2191	4313	Glenn	Sacramento River	108	2.70		4,500
Arthur L. and Alex J. Kerr, Margaret Marchand, Jeannette and Alice M. Stormer, Virginia E. Tate and Myrtle E. Kyne	2192	4314	Glenn	Sacramento River	270	4.48		4,500
Irwin N. McVay	2193	4315	Glenn	Sacramento River	205	5.11		4,500
Grace and Virginia McVay	2194	4316	Glenn	Sacramento River	266	6.64		4,500
Emil Jacobson	2196	4318	Glenn	Sacramento River	105	2.62		4,500
Malvina E. Williams	2197	4319	Glenn	Sacramento River	193	4.57		4,500
Walter G. and C. M. Reichel	2199	4326	Glenn	Sacramento River	121	2.02		4,500
Elliot H. Wheeler	2215	4301	Solano	Miner Slough	267	3.34		1,500
B. F. and Anna M. Burkhart	2216	3778	Los Angeles	Middle Fork of Pallett Creek	300		750	
Mary Ives Crocker	2218	4161	San Joaquin	Old River	306	3.80		12,000
L. N. Villa	2223	4334	San Bernardino	Springs in Mojave Desert	140	1.00		200
Lakeside Irrigation District	2226	4339	San Diego	Los Coches Creek	324	1.00		10,000
W. S. Kendall	2227	4364	Yolo	Sacramento River	582	7.25		8,000
Antone S. de Avilla	2235	4213	Siskiyou	Beaver Creek	165	2.06		
Elda Slack	2239	4431	San Joaquin	Old River	271	3.38		4,000
John Ohm	2241	4399	San Joaquin	San Joaquin River	1,055	13.19		11,000
Mrs. A. Banta	2242	4429	San Joaquin	Old River	272	3.19		4,150
M. J. Lund	2243	4432	San Joaquin	Old River and Grant Line Canal	1,290	16.13		9,000
L. A., Mary A., E. L., and F. C. Bixler	2244	4452	San Joaquin	Grant Line Canal and Middle River	2,572	32.15		63,000
M. Rossi	2245	4472	San Joaquin	San Joaquin River	197	2.46		3,500
Harry C. Finck	2246	4506	San Joaquin	San Joaquin River	313	3.92		8,000
William C. Ferguson	2247	4512	San Joaquin	Grant Line Canal	463	5.79		16,000

TABLE 30—Continued.

Important Permits Issued for Agricultural Purposes During Biennial Period Ending September 1, 1926.

NOTE—All projects of 100 acres or more are listed by name. Projects of less than 100 acres, including permits for domestic, stock and industrial uses are shown as a single group at the end of the table. Cancelled filings are not included.

Name of permittee	Permit number	Application number	County	Source of supply	Acres irrigated	Second feet granted	Acre-feet granted	Estimated cost
William, William C., and Alfred Ferguson	2248	4513	San Joaquin	Grant Line Canal	1,017	12.72		$16,000
Lewis Moreing	2252	4451	San Joaquin	San Joaquin River	340	4.25		17,000
Lewis Moreing	2253	4470	San Joaquin	San Joaquin River	1,131	14.14		34,000
Moreing Brothers	2254	4471	San Joaquin	San Joaquin River	627	7.83		14,000
Patterson Ranch Company	2255	4237	Stanislaus	San Joaquin River	2,189	27.36		35,000
E. C. and Kate C. Hart	2257	4165	Siskiyou	Little Shasta River	1,725		600	9,200
Robert Trost	2261	4233	Madera	Chowchilla River	261	3.25		200
Alfred S. and Wm. C. Ferguson	2268	4635	Contra Costa	Old River and Western Canal	977	12.21		11,000
James Mulcahey	2271	4430	San Joaquin	Stanislaus River	164	2.05		4,500
J. A. Bennett	2273	4454	San Joaquin	Potato Slough	121	1.51		1,000
Caroline Moran	2274	4637	San Joaquin	Middle River	995	12.44		9,000
River Junction Reclamation District No. 2064	2277	4460	San Joaquin	Stanislaus River	5,783	72.29		7,500
N. D. Hack	2282	4350	Sacramento	Sacramento River	100	1.25		1,000
Mojave River Irrigation District	2298	438	San Bernardino	Deep Creek and West Fork Mojave River	26,878		30,000	1,700,000
Mrs. Anna Fabian, Fred Tocklas and A. Grunauer	2299	4275	San Joaquin	Old River	1,422	17.50		15,000
A. Grunauer, Louis Krohner and M. Grunauer	2300	4276	San Joaquin	Old River	2,515	29.87		25,000
F. D. Popejoy and Jackson Mullings	2302	4517	Butte	Big Frey, Little Frey and Grubbs Creeks	100	1.25		1,500
Richard Hemmeth, R. W. Bassman, Fred Gansberg, Fred Bruns, Joseph Soosen and D. Wennhold	2306	4019	Alpine	Three unnamed gulches	930		750	
Royal A. Payne and Gertrude Payne French	2307	992	Modoc	Fitzhugh Creek	251		837	
Royal A. Payne	2308	993	Modoc	Fitzhugh Creek	140		457	10,000
Gertrude Payne French	2309	994	Modoc	Fitzhugh Creek	120		157	1,500
H. G. Payne, trustee of estate of Laura A. Payne	2310	1252	Modoc	Fitzhugh Creek	160		400	500
Thomas O'Brien	2314	4192	Ventura	Sam Young Spring	151	.13		1,700
R. A. Harper	2316	4554	Modoc	Dutch Flat drainage area	160	2.00		100
John J. and Amanda Hickey	2324	4537	San Joaquin	Burns cutoff	220	2.75		
Rose V. Jones	2325	4018	El Dorado	Little Iowa Creek	138	.15		
Paradise Irrigation District	2326	92	Butte	Little Butte Creek	11,100	50.00	4,148	125,000
Paradise Irrigation District	2327	2894	Butte	West Branch of Feather River			3,000	325,000
Paradise Irrigation District	2328	3437	Butte	West Branch of Feather River			5,000	
E. T. Larsen	2329	3105	El Dorado	Brush Canyon	100	1.25	60	5,000
E. Hartwick	2330	4502	El Dorado	Brush Canyon	120		80	2,500

C. Skrable	2331	4480	Napa	Putah Creek	100	1.25		4,000
Charles Moreing	2337	4507	Stanislaus	San Joaquin River	734	9.17	--	23,000
United States Reclamation Service	2339	2212	Glenn	Stony Creek	21,000		50,200	1,200,000
Victor, Valdemar, Peter, Boris, Leo, George and Sophia Cherbak, Inna Domens, James A. Anderson, and A. K. Toez	2341	4558	San Bernardino	Underground waters	325	2.00		15,000
T. D. Lewis	2342	4562	San Joaquin	San Joaquin River	204	2.55		2,700
A. L. Martin	2344	4556	San Bernardino	Crystal Creek and spring	320	3.00		
Carrie B. McDougald	2346	4568	San Joaquin	San Joaquin River and French Camp Slough	451	5.64		12,000
Tia Juana River Irrigation District	2348	2925	San Diego	Tia Juana River	1,515		1,600	226,000
Anna F. Windeler	2350	4569	San Joaquin	San Joaquin River	314	3.93		9,000
R. J. Treder	2353	4609	San Joaquin	San Joaquin River	238	2.98		4,400
Mary O. Petchner	2355	4596	Los Angeles	Bear Gulch	140	1.75	200	15,000
Mrs. Annie Fabian, F. Tocklas and A. Granauer	2356	4274	San Joaquin	Paradise Slough	453	5.66		9,000
Paul Bancroft and Philip Bancroft	2357	4607	Stanislaus	Tuolumne River	498	6.22		25,000
E. W. Campbell	2359	4566	San Diego	Vallecito Creek	120	1.50		7,000
Union Sugar Company	2362	4628	Santa Barbara	San Antonio Creek	843	10.54		3,000
Union Sugar Company	2363	4692	Santa Barbara	Santa Ynez River	288	3.60		
George E. Springer	2364	4699	Sutter	Sacramento River	160	2.00		25,500
W. D. Duke	2368	2904	Siskiyou	Parks Creek	2,100		850	50,000
George T. Simpson	2388	4685	San Diego	Santa Maria Creek	135	1.69	150	6,000
California Land Finance Company	2394	4766	San Joaquin	Fourteen Mile Slough	1,702	21.20		33,600
Peterson Farms Company	2398	4720	San Luis Obispo	Los Osos Creek	140	1.75	10	2,500
Mrs. Anna Bautz	2401	4636	San Joaquin	Middle River	155	1.93		3,000
Jay C. Wemple	2406	4730	Lassen	Mill and Dry Creeks	170	2.12	200	2,500
Grover C. Jackson	2415	4593	Modoc	Bull Creek	150	1.87		200
North Sacramento Land Company	2419	4385	Sacramento	Sacramento River	640	8.00		15,000
Paul N. Nunn et al., trustees of Deep Springs, an educational institution	2425	4584	Inyo	Deep Spring, Buckhorn Spring and other springs	1,560	10.00		15,000
Burchard Fine	2426	4682	Inyo	East Sacatar Creek	120	1.00		800
J. J. Fleming	2431	4412	Lassen	Secret Valley Creek	2,033		4,500	6,600
Walter A. Perry	2434	4820	San Joaquin	Old River	203	2.53		4,000
E. L. Adams	2447	4663	Butte	Hamlin Slough	1,215	22.50		400
Gorrill and Hotchkiss	2448	4664	Butte	Hamlin Slough	2,338	22.50		250
Montague Irrigation District	2452	3544	Siskiyou	Shasta River	19,500		55,000	1,200,000
Montague Irrigation District	2453	3555	Siskiyou	Parks Creek			15,000	
P. N. Ashley	2464	4822	Butte	Lateral "A," Reclamation District No. 833	305	7.00		1,400
Bill Gianella	2465	4859	Butte	North Honcut Creek	265	3.00		1,500
Thomas W. Arnold and Charles T. Sorenson	2481	4866	San Luis Obispo	Pozo Creek	168	.12	18	5,000
D. Muller	2485	4922	San Joaquin	San Joaquin River	172	2.15		2,500
M. Bronich	2486	4921	San Joaquin	Old River	240	2.99		2,000
Matie S. Vail	2487	4894	San Joaquin	Beaver Slough	651	8.10		32,500
Water Conservation Association	2488	2217	San Bernardino	Santa Ana River	52,640		48,000	1,979
S. Sweet Company	2489	4123	Yolo	Borrow Pit of Reclamation District No. 999	3,698	23.00		30,000
S. Sweet Company	2490	4124	Yolo	Borrow Pit of Reclamation District No. 999	620	7.12		
Oroville-Wyandotte Irrigation District	2492	2778	Butte	Lost Creek	31,463	50.00	25,000	820,500
Carmichael Irrigation District	2498	4743	Sacramento	American River	3,100	10.00		120,000
E. L. Cunningham	2500	4849	Mendocino	East Fork Russian River	132	1.65		
P. N. Ashley	2501	4856	Butte	Main Drainage Canal, Drainage District No. 100	356	8.91		1,150
Preston School of Industry	2505	2774	Amador	Sutter Creek	664	8.30	3,750	75,000

TABLE 30—Continued.

Important Permits Issued for Agricultural Purposes During Biennial Period Ending September 1, 1926.

NOTE. All projects of 100 acres or more are listed by name. Projects of less than 100 acres, including permits for domestic, stock and industrial uses are shown as a single group at the end of the table. Cancelled filings are not included.

Name of permittee	Permit number	Application number	County	Source of supply	Acres irrigated	Second-feet granted	Acre-feet granted	Estimated cost
William J. Sheldon	2507	4388	Sacramento	Cosumnes River	200	2.50		$4,300
Mossdale Farms, Incorporated	2508	4141	San Joaquin	Mokelumne River	300	3.75		
N. H. Locke Company	2509	4142	San Joaquin	Mokelumne River	335	4.19		
Terminous Farms Company	2512	4400	San Joaquin	South Fork Mokelumne River	397	4.96		5,000
Frank L. Fisher	2514	4901	Yolo	Sacramento River	990	22.00		5,500
Frank L. Fisher	2515	4902	Yolo	Sacramento River	650	8.12		900
Mrs. P. J. Braun	2516	4841	Yolo	Sacramento River	277	6.93		4,500
W. F. Detert	2517	4889	Lake	Bucksnort Creek	1,002	6.25	600	100,000
Peter L. Swanson and Lillian J. Swanson	2519	3657	San Benito	San Benito River	186	1.40		5,000
Charles S. Luce	2522	4908	Yolo	Sacramento River	229	2.86		3,500
Walker River Irrigation District	2534	1097	Mono	West Walker River	160,000		35,000	918,000
Walker River Irrigation District	2535	1098	Mono	West Walker River			115,000	
Walker River Irrigation District	2536	1389	Mono	East Walker River			57,000	
Walker River Irrigation District	2537	2221	Mono	West Walker River			85,000	
Walker River Irrigation District	2538	2615	Mono	Unnamed stream			200	
James Kincheloe	2547	4838	Riverside	Bedford Canyon	245	3.00		18,000
Victor L. Bentson	2553	2302	San Luis Obispo	Arroyo Grande Creek	379	4.74		20,000
T. L. Quigley	2560	4862	Butte	Lateral "A," Drainage Canal, Reclamation District No. 833	892	20.00		5,000
Estate of C. M. Faris	2561	4887	Butte	Lateral "A," Drainage Canal, Reclamation District No. 833	591	13.27		2,000
Carl N. Hewitt and A. Logan	2563	4077	San Bernardino	Sawpit Creek and Sawpit Springs	140	.60	100	15,000
Ellen M. H. Lewis	2566	4864	Yuba	Nigger Jack Slough	308	3.85		
San Dimas Water Company	2578	3532	Los Angeles	Puddingstone or Walnut Creek	1,927		2,150	160,000
Montague Irrigation District	2582	4912	Siskiyou	Little Shasta River	17,150	50.00		300
Rindge Land Reclamation District No. 2036	2590	4942	Contra Costa	Old River, Rock Slough and Indian Slough	2,465	30.80		
Rindge Land Reclamation District No. 2037	2591	4943	San Joaquin	San Joaquin River, Disappointment Slough, 12 Mile Slough, 14 Mile Slough	6,837	85.45		
Rindge Land Reclamation District No. 2038	2592	4944	San Joaquin	Empire Cut, Whiskey Slough and Middle Slough	5,739	71.74		
Rindge Land Reclamation District No. 2039	2593	4945	San Joaquin	Trapper's Slough and Middle River	6,289	78.60		
Herbert W. Barmann	2596	4951	Butte	Canal, Drainage District No. 100	1,293	10.00		1,000
Viola A. Dailey	2601	5018	Trinity	Panther Creek	100	1.25		3,000
Charles Bloom	2602	4911	Butte	Ditch "B," Drainage District No. 200	106	2.65		1,000
Sheep Creek Water Company	2605	3883	San Bernardino	Sheep Creek	1,920		3,000	150,000
422 smaller projects					**8,845**	**160.79**	**1,130**	**937,520**

TABLE 31.

Permits Issued for Power Purposes During Biennial Period Ending September 1, 1926.

Name of permittee	Permit number	Application number	County	Source of supply	Second-feet granted	Acre-feet granted	Theoretical horse-power to be developed	Estimated cost
Sovereign Comet Gold Mining Company	1825	3827	Sierra	Jim Crow Canyon	3.00		153	$10,000
Sovereign Comet Gold Mining Company	1826	3920	Sierra	Ladies Canyon	5.00		128	
W. S. Allen and L. L. Cuneo	1828	3787	Amador	Sutter Creek	1.00		28	1,000
The Nevada-California Power Company	1833	3969	Mono	Rush Creek		1,742	2,016	19,845
Table Mountain and Thermalito Irrigation District	1912	3040	Butte	Concow Creek		8,200	3,011	115,015
Claude E. Williams	1916	3970	Madera	North Fork of Willow Creek	2.00		15	1,500
Fenton J. Zehner (Gray Eagle Lodge)	1979	4023	Plumas	Gray Eagle Creek	3.00		6	600
H. L. Shannon	1983	3257	Tehama	Deer Creek	150.00		10,227	1,000,000
James C. Foss, Jr	1992	3856	Tuolumne	Jawbone Creek	2.00		57	
James C. Foss, Jr	1993	3886	Tuolumne	Jawbone Creek	2.00		57	
Pacific Gas and Electric Company	2004	2749	Butte	Clear Creek		5,740	4,791	253,900
Pacific Gas and Electric Company	2005	2752	Butte	West branch of North Fork of Feather River		3,700	3,593	182,000
Pacific Gas and Electric Company	2006	2755	Butte	West branch of North Fork of Feather River		5,060	4,791	134,400
C. E. Segerson and Mrs. L. Magnus	2065	4006	Tulare	Poso Creek	4.00		5	200
C. M. Jones and W. W. Slayden	2073	3699	Tulare	Tulare Lake Watershed	24.00		183	15,000
Nevada Irrigation District	2083	2272	Nevada	South Fork of Middle Yuba River		5,000	12,927	75,000
Nevada Irrigation District	2084	2275	Nevada	Middle Fork Yuba River		75,000	12,927	4,965,160
Nevada Irrigation District	2087	2372	Nevada	Canyon Creek, Texas Creek, Fall Creek, South Branch of Fall Creek	300.00	65,000	12,927	4,006,460
Pacific Gas and Electric Company	2100	2100	Amador	North Fork of the Mokelumne River	350.00	60,000	49,597	6,000,000
Pacific Gas and Electric Company	2101	2548	Amador	Cole Creek, Bear River and Beaver Creek	350.00		49,597	6,000,000
Pacific Gas and Electric Company	2102	2996	Amador	North Fork of Mokelumne River	225.00		37,483	250,000
Sierra and San Francisco Power Company	2105	2460	Calaveras, Tuolumne	Stanislaus River	2,000.00	150,000	53,409	3,500,000
Frank Becker	2119	3687	Calaveras	Licking Fork Mokelumne River	6.00		75	1,000
Mary A. Thompson	2154	3979	Inyo	Surprise Canyon	1.25		28	12,000
Walter G. Muncy	2183	4265	Del Norte	Kelley's Gulch	3.00		51	2,500
City of Los Angeles	2259	4435	Inyo	Scotty Springs	.90		172	1,041
Feather River Power Company	2290	2195	Plumas	Bucks Creek		55,000	106,949	
Feather River Power Company	2291	3889	Plumas	Bucks Creek		23,000		
Feather River Power Company	2292	4441	Plumas	Bucks Creek		40,000		
Feather River Power Company	2293	4453	Plumas	Milk Ranch Creek and three unnamed tributaries	35.00	1,000		
Feather River Power Company	2294	4491	Plumas	Bucks Creek and Grizzly Creek	175.00			
Feather River Power Company	2295	4598	Plumas	Grizzly Creek	105.00			
Feather River Power Company	2296	4599	Plumas	Milk Ranch Creek and Feather River	40.00			
Solon F. Luzzadder	2334	4533	Plumas	Unnamed spring	.62		4	500
Peacock Mining Company	2335	4487	Humboldt	Camp Creek	16.00		96	3,600
P. B. Cross	2410	4575	Tehama	Deer Creek	150.00		18,629	1,669,648
Tahoe Electric Power Company	2414	3895	El Dorado	Star Lake		320	357	2,000

TABLE 31—Continued.

Permits Issued for Power Purposes During Biennial Period Ending September 1, 1926.

Name of permittee	Permit number	Application number	County	Source of supply	Second-feet granted	Acre-feet granted	Theoretical horse-power to be developed	Estimated cost
San Joaquin Light and Power Corporation	2416	4573	Tulare	Wilson Creek and Morehouse Creek Spring	6.00		1,049	$11,500
John A. Kresge	2423	4794	Modoc	Ash Creek	.10		1	500
El Dorado Power Company	2455	4057	El Dorado	Silver Fork of American River	250.00	7,500	24,858	3,659,000
El Dorado Power Company	2456	4687	El Dorado	Silver Fork of American River		7,500	122,564	
Western States Gas and Electric Company	2457	4686	El Dorado	Silver Fork of American River		7,500	27,982	
Mrs. W. A. Price and E. G. Galt	2462	4564	El Dorado	Grass, Gilmore, Susie, Halfmoon, and Heather Lakes	1.00	464	119	
San Joaquin Light and Power Corporation	2493	1918	Fresno	North Fork Kings River and North Fork Rancheria, Rancheria and Statum Creeks	450.00		7,102	3,500,000
San Joaquin Light and Power Corporation	2494	2024	Fresno	Helms Creek	125.00		23,011	2,500,000
San Joaquin Light and Power Corporation	2495	4703	Fresno	North Fork Kings River	220.00		141,750	32,300,000
San Joaquin Light and Power Corporation	2496	4704	Fresno	North Fork Kings River and Fleming, Post Corral and Helms Creeks	330.00		60,750	10,000,000
Arthur B. Riehl	2503	4416	Plumas	South Branch of Middle Fork of Feather River	10.00		241	2,000
Preston School of Industry	2506	2775	Amador	Sutter Creek	10.00	3,750	309	75,000
East Bay Municipal Utility District	2529	4768	Amador, Calaveras	Mokelumne River	375.00	217,000	13,849	6,000,000
Feather River Power Company	2554	4869	Plumas	Pebble Creek and (3) unnamed branches Milk Ranch Creek	5.00		1,450	7,700,000
Feather River Power Company	2555	4870	Plumas	Branch of Bucks Creek, Bear Trap Creek, Slide Creek, Forked Ravine and Bear Ravine	17.00		4,930	
Feather River Power Company	2556	4871	Plumas	Grizzly Creek	20.00		5,800	
James B. Knight, Fred M. Kay, J. L. Stone, W. H. Haw, Frank Breeden and David Wilson	2576	4630	Trinity	New River	62.50		5,433	110,000
Jonas Hirsch	2588	5000	Nevada	Juniper Creek	1.00		26	
Abe Duncan	2594	4967	El Dorado	Forni Creek	.50		6	500
Pacific Gas and Electric Company	2604	5004	Yuba	North Fork of Yuba River		15,000	7,955	

TABLE 32.

Permits Issued for Mining Purposes During Biennial Period Ending September 1, 1926.

Name of permittee	Permit number	Application number	County	Source of supply	Second-feet granted	Acre-feet granted	Estimated cost
W. S. Allen and L. L. Cuneo	1827	3754	Amador	Sutter Creek	1.00		$1,000
John Amick	1834	3834	Inyo	Barrel Springs	.50		800
Shelby W. Coskrey	1839	3960	Trinity	Bidden Creek and an unnamed creek	3.00		500
Big Pine Mining Company	1842	3913	Inyo	Waucobe Canyon	.02		10,000
Frank H. Long	1861	4016	Inyo	Coulter Spring	.05		1,000
George Weston	1932	4090	El Dorado	Oregon Gulch	1.25		
The Gypsum Plaster Company	1945	4114	Los Angeles	Gypsy Spring	0.05		1,200
C. A. Austin	1987	4145	Trinity	New River	50.00		8,000
Jay Woodfill and Cleve J. Barry	2001	4053	Siskiyou	Eddy Gulch	3.00		950
R. N. Scheller	2025	4322	Sierra	Unnamed springs (6)	3.00		250
William Flanigan	2030	4119	Siskiyou	Devils Canyon	3.00		350
K. T. Howe	2036	3538	Santa Clara	Uvas Creek	3.00		200
Skookum Placers Mining Association	2045	2972	Siskiyou	Buzzard Creek	12.00		1,500
Samuel J. Dunaway et al., assigned to Buzzard Hill Mine, Incorporated	2046	4199	Siskiyou	Buzzard Creek	3.00		100
Charles A. Giffen	2058	4175	Trinity	North Fork of Trinity River	25.00		30,000
Gus Perigot	2059	4241	Trinity	New River	125.00		75,000
The American Trona Corporation	2064	4408	Inyo	Mumford Springs	.13		1,500
Roxbury Gold Mines, Incorporated	2068	4015	Siskiyou	Canyon Creek and Kelsey Creek	80.00		70,000
Clifford R. Wiegel	2078	4044	Siskiyou	Nickelwaite Creek	1.00		500
J. O. McBroom, E. A. McBroom and C. Vincent	2093	3974	Siskiyou	Cecil Creek	37.50		4,000
Mary A. Thompson	2116	3998	Inyo	Spring in Pleasant Valley	.50		1,000
James T. Whittlesey	2126	3708	Calaveras	Eldorado Creek and Murray Creek	8.00	20	300
John Bernard Graham	2128	3792	Trinity	Mule Creek	1.00		1,000
Delmer Joy Nave and S. E. Nave	2146	3171	Sierra	Second Ravine	3.00		500
Revenue Copper Company, Incorporated	2186	4278	Inyo	Knights Canyon and an unnamed tributary	.15		3,000
Harry W. Nickerson	2213	4270	Inyo	Willow Creek	1.00		5,000
J. E. West	2224	3035	Sierra	Hepsydam Creek	5.00		3,000
J. E. West	2225	3549	Sierra	Whiskey Creek	60.00		2,000
Clarence A. Sullens	2236	3245	Plumas	Kellogg Ravine	3.00		650
S. D. Root	2266	4389	Shasta	Sulphur Creek	1.00		250
J. F. Baker	2276	4459	Plumas	Indian Creek	2.50		
Louis Leidy	2303	4295	Mono	Deer Spring	.02		1,000
Adrian D. Joyce	2311	4538	Shasta	Squaw Creek	1.10		10,000
Frank Thomas	2317	4337	Inyo	Underground water	.12		500
Judson Estate Company	2323	3719	Sierra	Ravines (8) tributary to Canyon and Slate Creeks	40.50		6,000
Max Paul Boehme	2338	4540	Plumas	Mill Creek	2.00		12,000
J. F. Foster	2366	4655	Sierra	Nigger Canyon	3.00		500
Clyde E. Tilford	2390	4671	Sierra	North Star Creek	.50		250
William B. Salstrom	2399	2384	Humboldt	Indian Creek	3.00		1,000

TABLE 32—Continued.

Permits Issued for Mining Purposes During Biennial Period Ending September 1, 1926.

Name of permittee	Permit number	Application number	County	Source of supply	Second-feet granted	Acre-feet granted	Estimated cost
E. J. Curran	2405	4784	Siskiyou	Jessops Gulch	3.00		$800
Clifford R. Wiegel	2407	4734	Siskiyou	Nickelwaite Creek	.20		300
J. A. Macdonald	2409	4595	Trinity	Sugar Pine Creek	3.00		100
Oliver Cutts	2430	4132	San Bernardino	Unnamed branch of Lytle Creek	50.00		10,000
Frank H. Stanley	2433	4634	Imperial	Unnamed stream	.20		1,000
Fred W. Burk	2440	4735	Orange	Springs (2) Left Fork Live Oak Canyon	.01		500
G. C. Williams	2461	4624	Siskiyou	Oak Flat Creek	20.00		8,000
Golden Chariot Mining Corporation	2524	4905	San Diego	Unnamed stream	.30		2,000
James Wilson Martin	2528	4833	Sierra	Hungry Mouth Ravine	25.00		1,000
George W. Seybold	2533	4779	El Dorado	McKeney Creek	3.00		300
Humboldt Placer Mining Company	2543	2665	Trinity	Stuart's Fork of Trinity River	75.00		250,000
Humboldt Placer Mining Company	2544	2666	Trinity	Owen's Creek and South Branch Owen's Creek	25.00		7,000
Humboldt Placer Mining Company	2545	2667	Trinity	Van Matre Creek	25.00		5,600
Humboldt Placer Mining Company	2546	2678	Trinity	Slate Creek	25.00		200
J. I. Prugh	2565	5008	Plumas	Unnamed spring	.01		300
Samuel B. Noel and Al H. Paulson	2567	4726	Plumas	Lake Ravine	2.00		500
H. C. Conger and E. E. Randolph	2568	4793	Yuba	Burnt Bridge Creek	2.00		2,000
James B. Knight, Fred M. Kay, J. L. Stone, W. H. Haw, Frank Breeden and David Wilson	2577	4631	Trinity	New River	62.50		55,000
A. Humphreys	2579	4885	Sierra	South Fork of North Fork of Yuba River	40.00		10,000

TABLE 33.

Permits Issued for Municipal Purposes During Biennial Period Ending September 1, 1926.

Name of permittee	Permit number	Application number	County	Source of supply	Second-feet granted	Acre-feet granted	Population to be served	Estimated cost
City of Napa	1821	3172	Napa	Milliken Creek		2,000	10,000	$300,000
City of San Diego	2120	2992	San Diego	Flume Nine Creek		12,000	200,000	1,300,000
City of San Diego	2121	2993	San Diego	Rattlesnake Creek		18,000		
City of San Diego	2122	2994	San Diego	Tunnel Two Creek		2,000		
City of San Diego	2123	2995	San Diego	Matchin Creek		2,000		
The McCloud River Lumber Company	2155	4561	Siskiyou	McCloud River	5.57		3,000	75,000
City of Los Angeles	2258	4434	Inyo	Scotty Springs	1.00			1,041
Central Mendocino County Power Company	2352	4572	Mendocino	James Creek	2.00	635	12,500	40,000
City of Santa Cruz	2372	4017	Santa Cruz	San Lorenzo River	6.20		30,000	60,000
North Sacramento Light and Water Company	2420	4386	Sacramento	American River	12.40		27,000	25,000
East Bay Municipal Utility District	2459	4228	Amador, Calaveras	Mokelumne	310.00	217,000	2,500,000	80,000,000
Bolinas Public Utility District	2550	4881	Marin	Arroyo Hondo Creek	1.00		1,500	50,000
City of San Luis Obispo	2551	1990	San Luis Obispo	Lopez Creek	2.32		15,000	600,000
City of San Luis Obispo	2552	2916	San Luis Obispo	Lopez Creek		1,799		
Montague Irrigation District	2581	4909	Siskiyou	Little Shasta River	2.30		2,000	8,000

○

SIXTH REPORT

OF THE

California Department of Agriculture

FOR THE

PERIOD ENDING DECEMBER 31, 1925

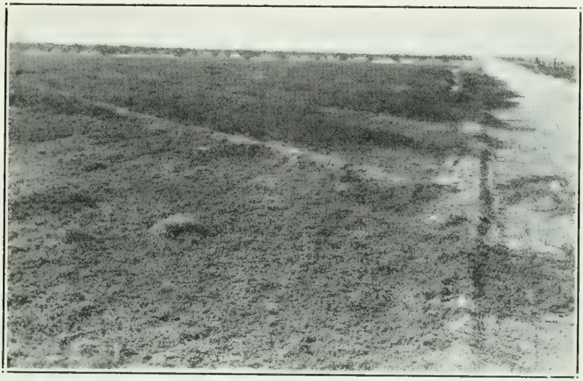
SACRAMENTO, CALIFORNIA

CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1926

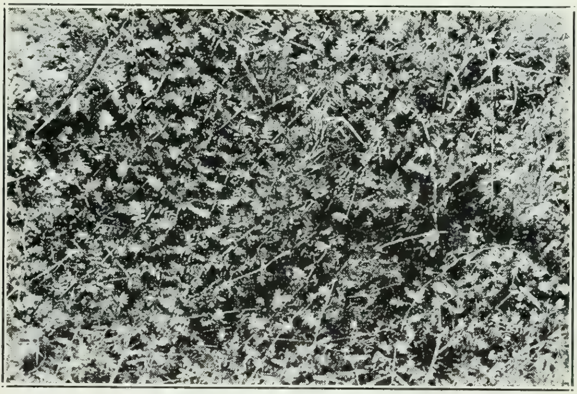
45682

CONTENTS.

Page
Letter of Transmittal-- 133
Foot and Mouth Disease Epizootic----------------*G. H. Hecke* 135
Bureau of Plant Quarantine and Pest Control---*W. C. Jacobsen* 146
  Plant Quarantine Inspection Service-----------*A. C. Fleury* 149
  Special Regulatory Pest Control----------------*D. B. Mackie* 159
  General Entomology-------------------------*T. D. Urbahns* 172
  Plant Pathology----------------------------*D. G. Milbrath* 178
  Rodent Control---------------------------*Norman G. Buhn* 187
  Predatory Animal Control--*Chas. G. Poole* and *W. C. Jacobsen* 188
  Weed Control---------------------------*Ethelbert Johnson* 190
  Nursery Service-------*R. D. Hartman* and *Everett L. Smith* 197
  Viticultural Service---------------------------*R. L. Nougaret* 198
Bureau of Fruit and Vegetable Standardization--*W. F. Allewelt* 202
Bureau of Grain, Seed and Warehouse Standardization-------- --*L. M. Jeffers* 207
  Seed Inspection---------------------------*W. S. Wilkinson* 208
Division of Animal Industry--------------------*J. P. Iverson* 215
  Meat Inspection----------------------------*George Gordon* 229
  Cattle Protection Service-----------------*Arthur Hebbron* 231
Bureau of Dairy Control----------------------------*J. J. Frey* 235
Division of Chemistry----------------------------*Geo. P. Gray* 253
  Dairy Laboratory--------------------------------*C. F. Hoyt* 258
Division of Weights and Measures---------------*C. F. Hayden* 263
Market News Service-------------------------------------- ---------------*O. W. Holmes, C. J. Hansen, W. E. Schneider* 273
California Crop Report-----------------------*E. E. Kaufman* 279

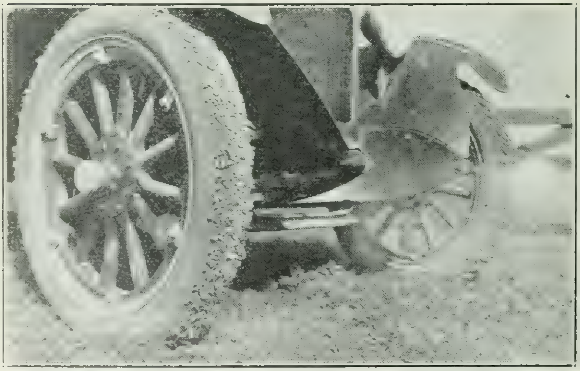


Alfalfa field invaded and productive plants choked out by puncture vine, rendering hay from such field dangerous for feeding to livestock and greatly reducing its sale value.



Close-up of puncture vine showing how completely the mat covers the ground. Commercial crops can not compete successfully.

Roadside heavily infested with mats of puncture vine showing readiness with which this weed adapts itself to hard, dry places.



Auto tires serve as one of the most important carriers of puncture vine by picking up the spiny burs which contain the seed.

LETTER OF TRANSMITTAL.

SACRAMENTO, CALIFORNIA,
June 15, 1926.

Honorable FRIEND WM. RICHARDSON,
Governor of the State of California,
Sacramento, California.

SIR: I have the honor to transmit herewith my report covering the activities of the Department of Agriculture for the calendar year of 1925. The issuance of this report has been purposely delayed in anticipation of the complete removal of state and federal quarantines on foot and mouth disease. This occurred June 10, 1926, exactly one year after the last deer showing active lesions of this destructive disease was killed.

With California free from this menace and the restrictions it caused, I think the time is fitting to acknowledge the excellent cooperation received from Secretary of Agriculture, William M. Jardine, and other officials of the U. S. Department, especially the following who were prominently identified with the campaign of eradication: Drs. J. R. Mohler, U. G. Houck and Rudolph Snyder of the Bureau of Animal Industry and Dr. R. A. Oakley of the Bureau of Plant Industry.

Very respectfully,

G.H.Hecke.

Director of Agriculture.

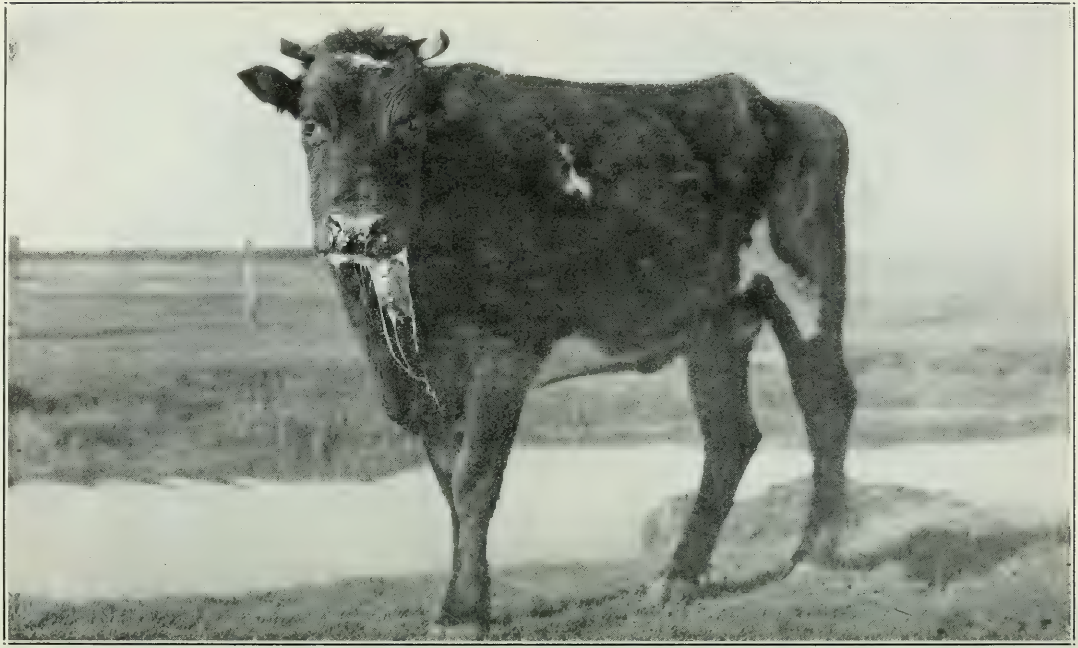


FIG. 1.—Animal exhibiting well marked symptoms of foot and mouth disease.

THE MONTHLY BULLETIN

DEPARTMENT OF AGRICULTURE

STATE OF CALIFORNIA

DEVOTED TO AGRICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical, biological and other publications of a similar nature.

G. H. HECKE, Director--Censor

Acceptance for mailing at the special rate of postage provided for in section 1103, act of October 3, 1917; authorized August 27, 1918.

Vol. XIV July–December, 1925. No. 7–12

THE FOOT AND MOUTH DISEASE EPIZOOTIC.

By G. H. HECKE, Director.

The live stock industry of the civilized world has no fiercer enemy, no stealthier foe than foot and mouth disease. Despite the utmost vigilance, it strikes when and where it is least expected. Once it has crossed the barriers into clean territory, it spreads with much speed; its power of infection is so great that only the severest, most radical measures, promptly applied, can check its spread and finally eradicate it, and this is possible only when the slaughter of infected and exposed animals is carried out as a definite program *without interference or exception.* Because of the damage it inflicts, because of the fear it inspires through the insidious speed of its uncanny spread, it can and does interfere with the normal economic activities of the stricken region. As the yellow fever panic in bygone days paralyzed the business of whole states in a day, so the fear aroused by foot and mouth disease can upset and prevent the orderly process of marketing the totally harmless orchard and field products of the affected districts and neighboring regions, thereby causing financial losses many times greater than the value of the infected herds. This panicky fear and its effect on the marketing of California's horticultural and agricultural products soon became apparent after the presence of foot and mouth disease had been definitely established February 23, 1924. Thereafter it became necessary not only to surround, corral, rope and exterminate the disease itself, but also to carry on a running fight with the blind fear which strove mightily to bar out of great American and foreign markets the clean output of California's horticulture. In both efforts the forces of the state and federal departments of agriculture succeeded. Foot and mouth disease *was* eradicated; and California's field, fruit, vegetable, melon and grape crops moved into consumption with only temporary, though vigorous, interference.

This report is not intended as a detailed history of the epizootic, but rather as a review of some of its salient features. At a future date a more or less complete history of the epizootic will be treated in a special bulletin, which I hope will furnish data and information that will be of value in the event of another outbreak of one of these foreign, destructive animal plagues.

Prior to the California outbreak, foot and mouth disease had sneaked into the United States six times. The last prior invasion occurred in October, 1914. It spread into 22 states and into the District of Columbia before the final infected herd was disposed of in May, 1916. Though the disease in the 1924 California outbreak did not go beyond the state line, we realized from the beginning that we had to fight it under unusual conditions. In none of the other outbreaks did the infection invade the range country in a manner comparable to that which occurred here. Such an unfortunate occurrence would, in former years, have made the task of control appear hopeless. The appearance of the disease among deer in the mountain wilderness ordinarily would have been disheartening, but such circumstances, unfortunate and discouraging as they were, served only to spur our regulatory forces on to greater efforts. Considering the sinister speed with which foot and mouth disease spreads, it can be seen also that misfortune was tempered by luck when the disease originated in a section of the state from which the natural movements of animals and their products are towards the large cities in the San Francisco Bay region. If we may judge from the strenuous efforts of the organized state and federal forces which were necessary to bring the epizootic under control when it eventually did invade the range country, it does not require much imagination to determine what might have happened if the origin of the disease had been in the range region before we were properly organized to contend with it.

Legal and Financial Aspects.

When in a few days following its discovery and positive diagnosis a rapid investigation revealed many nests of foot and mouth disease infection in Alameda, Contra Costa and Solano counties, with no telling how much existed elsewhere, the questions of law and finance became preeminent. Previous outbreaks of this disease in the United States had been successfully exterminated by radical measures which, among other things, called for the slaughter of not only the diseased but also the exposed susceptible animals, and the imposition of the most rigid quarantines covering large areas of territory in which the movements of animals were prohibited, and the movements of some agricultural products were regulated. Rapidity of action was an essential factor in the successful outcome of this campaign, and we proceeded on the assumption that the power and authority to do such things were vested in the Director of Agriculture, although there was no law then in existence in California that specifically empowered the state to slaughter exposed animals. Even under the general power of the state, providing for the protection of the health and property of its citizens, it was very questionable whether the authority which might be conferred by such power extended beyond the legal right to slaughter actually diseased animals, although in order to combat the disease the slaughter of susceptible exposed animals was just as essential as slaughter of the diseased. Furthermore, whether or not this power existed it could not be exercised unless the owners of slaughtered animals were adequately paid for them. It can be seen, therefore, that the question of finance was important. With the diagnosis of foot and mouth disease established, it became apparent that its eradication was no ordinary undertaking, but on the contrary would require the immediate strengthening of the efficient force of trained veterinarians in the Department to a size sufficient to cope with the emergency, and this required funds far in excess of the available appropriation for the control of infectious diseases of live stock.

Governor Friend Wm. Richardson, the State Board of Control, and the State Controller quickly and fully appreciated the dangerous situation with which the state was confronted. With their approval the funds with which to recruit the animal industry division up to the necessary strength and to defray huge but necessary operating expenses, were provided out of an emergency appropriation. But this action still left the hardest part of the financial problem unsolved, for no funds were available with which to pay the state's share of the indemnity claims for animals slaughtered and property destroyed. Large scale and rapid slaughter of infected herds was necessary to eradicate the disease, yet there existed *no legal authority for the slaughter of merely exposed animals* and there *was no state money available to indemnify the owners.* The necessity for slaughtering merely exposed animals in which the disease had not appeared was difficult for some of the owners who were not familiar with the disease to understand; and this, together with no positive assurance of financial reimbursement, might naturally have produced a state of mind which would cause them to oppose by force the destruction of their herds. Thus the work began with the fear that live stock owners might halt its progress by resorting to legal or other means to stop the slaughter of animals. Had such an attitude been taken by even a few owners, the consequences would have been disastrous both to the live stock industry and to the economic welfare of the state as a whole. It was necessary to prevent such a catastrophe, and in order to make plans for the raising of an indemnity fund, the Director of Agriculture called several conferences of federal officials, leading representatives of the University of California and of the agricultural and other industries of California. A conference early in March with the Governor, State Superintendent of Banks, State Board of Control and Controller, resulted in requesting the California Bankers' Association to use its influence to have the banks of California advance funds with which to pay indemnity claims.

The Governor supported this request with the statement that he would urge and support relief measures to be passed by the ensuing legislature for any advance so made, and in conformity therewith he telegraphed members of the legislature requesting assurance that they would approve of a deficiency appropriation for this purpose, and the replies were favorable. Having thus reinforced his stand on legislation he met with the Executive Council of the California Bankers' Association and as a result the bankers rolled up their sleeves and raised $500,000, which sum was advanced to the State Department of Agriculture. This enlightened and farsighted compliance with the Governor's request, by the legislature and the California Bankers' Association, came at a critical moment, and followed as it was by a special congressional appropriation to pay the federal government's share, it allayed the fears of the live stock owners, saved them from serious financial embarrassment and removed potential resistance. It resulted in increased cooperation, heartened and put extra pep and vigor into the work of the control forces and made all understand that the legislative and financial interests of California were solidly backing the efforts to suppress the disease.

Later in the year this half million was exhausted and the Director of Agriculture appointed a committee composed of representatives of the State Department of Agriculture, live stock association officers and bankers, for the purpose of raising further advances. This committee visited and put before the individual banks in the infected counties the need of immediate financial assistance for those individuals in their counties who had suffered losses from foot and mouth disease. The result was that further credits to the amount of over a million dollars were received from these banks.

The cost of eradicating the epizootic was $6,151,382.75.* Out of this total the sum of $4,350,008.16, shared equally by the state and federal governments, was paid for animals slaughtered and property destroyed. The balance, $1,801,374.59 covered the cost of operating expenses. In addition the various counties expended approximately $800,000.

The number of animals destroyed was 109,855, divided as follows:

Cattle	58,807
Sheep	28,382
Swine	21,194
Goats	1,472

Finally the Governor, in a message to the forty-sixth session of the legislature, urged the appropriation of funds to cover such expenditures, and the legislature, without a dissenting vote, appropriated $2,238,900.27 to liquidate the state's share of unpaid indemnity claims, and the advances made by the banks of California.

Embargoes.

To the direct losses due to the disease itself, including expenditures for control and indemnification, must be added the even larger indirect losses caused by interference with business by embargoes and restrictions imposed within this state and by other states and foreign countries. Many of these embargoes and restrictions which applied to commodities not of animal origin were, in the opinion of live stock sanitary experts of wide experience, unnecessary and unjustified. They were brought about in most instances by a hysterical fear that seemed to sweep like a wave not only over foreign markets, many western and some eastern states, but throughout parts of this state as well. California was therefore suddenly awakened from its sense of security, and its agricultural and other business interests were made to realize how closely the general economic welfare of the state is dependent upon and interwoven with the work of the regulatory forces in the control and eradication of plant and animal diseases. The almost hysterical building of the embargo wall against California products began immediately after the presence of the foot and mouth disease had been definitely established. By good fortune the first outbreak was discovered in February before the state's great field and fruit crops were ready for marketing, yet the shipment not only of animals but of all other agricultural products was disturbed and interfered with sufficiently to cause general apprehension. Drastic and effective action had to be taken immediately to counteract the numerous wild rumors, place the full truth about the situation before the officials and the citizens of adjacent states, and through the promulgation of the facts prevent a complete blockade of California. To arrive at the most efficient means of spreading the truth a series of conferences was held in Sacramento with members of the Agricultural Council and other leading representatives of the agricultural industry. These conferences appointed committees to visit with the governors and agricultural officials of the western states in an effort to have the embargoes so modified that while they would still offer protection to these states, they would also afford California an opportunity of marketing her products. The action culminated in a meeting of western states agricultural officials in Salt Lake City, Utah, April 1, 1924, at which time uniform regulations were adopted by the various states represented. They have since been known as the "Salt Lake Conference Regulations" and one state after another proceeded to adopt them. In brief, instead of prohibiting shipments of practically all agricultural products, they provided among other things that nursery stock, fruits and vegetables could be shipped from approved areas when packed with new paper or excelsior and when accompanied by a certificate of the State or Federal Department of Agriculture certifying that the shipment originated on premises free from foot and mouth disease infection. These regulations also made similar provisions for the shipments of most field crops, excepting hay and straw, and provided methods for the safe shipment of eggs and baby chicks. Under the direction of the chiefs of the Bureau of Plant Quarantine and Pest Control and Bureau of Fruit and Vegetable Standardization of this Department, immediate arrangements were made with the fifty county horticultural commissioners and their three hundred deputies to handle this work. In this emergency the value of close cooperation between the state department and the county horticultural commissioners became evident. A most thorough inspection service was organized with remarkable speed, and the county horticultural commissioners assumed this extra burden without complaint and with great efficiency. While the figures have not been fully compiled, it is estimated that close to one million separate shipments, many of which were car lots, were certified under these provisions.

---

* As of May 31, 1926.

Federal Cooperation.

From the beginning the state was able to place in the field a trained, though relatively small, force of veterinary inspectors under the supervision of the Chief of the Division of Animal Industry, State Department of Agriculture. Likewise a trained force of veterinary inspectors of the U. S. Bureau of Animal Industry, also small in number, under the supervision of its inspector in charge, was thrown into the fight. The cooperation between the state and federal forces proceeded satisfactorily, but it became very evident to the Director of Agriculture during April that a much larger force of trained veterinarians was needed than could be had in California, and even a better organization of the forces and more effective results could be obtained by unifying the work under one command. For these reasons recommendations were made to the Governor that a committee of representative California citizens be sent to Washington, D. C., for the purpose of requesting the Secretary of the U. S. Department of Agriculture to assume responsibility and charge of all work in the field. In making this recommendation we were influenced by the nervous conditions existing in other states brought about by the long jump of the disease from Alameda into Merced County, and from there into Los Angeles County. At that time it was impossible to account for this extension of the disease into Merced County and most alarming rumors became prevalent in other states which naturally began to fear that they might be the next victims of the epizootic. Such a state of mind presaged a return to the drastic embargo conditions experienced prior to the Salt Lake Conference, but with the federal government in charge and the issuance of daily official bulletins it was felt that confidence would again be restored and California would at least be spared the resumption of embargoes which might interfere with or prevent the shipping of our principal agricultural crops. The late Secretary of Agriculture, Henry C. Wallace, and the Chief of the U. S. Bureau of Animal Industry, in complying with this request, placed a personal representative in charge on April 24, 1924, and results justified the step. Just as California would have greater confidence in the effectiveness of a federal than a New Jersey state quarantine against the Japanese beetle or a Florida quarantine against the citrus canker, or a Texas quarantine against the pink boll worm, so the officials of other states became reassured concerning the effectiveness of the measures to prevent spread of the infection from California when the federal department assumed responsibility. The psychological value alone justified the change. In a short time the panicky feeling began to abate, and the danger of a renewed blockade was averted. Immediately following the federal appointment the force was augmented by the assignment of some seventy additional United States veterinarians to the work, and in the several weeks prior to this change the state had recruited its forces up to maximum strength by employing all the practicing veterinarians in California who would accept appointments. All state inspectors were made collaborating federal inspectors and federal inspectors were commissioned as collaborating state officers. Thus the arrangement, both in the executive division and in the field, became eminently satisfactory and the control work proceeded smoothly and efficiently.

Incidentally it may be stated that in the latter part of September, 1924, foot and mouth disease was discovered in Texas. We had realized in California the advantages to be obtained from unified command, and being convinced that the control of such diseases should be more of a federal than a state function, we gladly responded to the call from the Governor of Texas for advice. In response to prompt advice concerning the results of federal control in California, he wired the Director of Agriculture, under date of October 2, 1924, as follows: "I followed the suggestion made by you and the federal government now has a superintendency of controlling the foot and mouth disease. Thanks to you for your suggestion. Pat. M. Neff, Governor."

California is now considered free from foot and mouth disease infection. The last outbreak in domestic animals occurred in Merced County, April 5, 1925. This was, however, a recurrence of the disease on a formerly infected farm due, no doubt, to some holdover virus not reached in the process of disinfection. The last outbreak in domestic animals on previously uninfected premises occurred October 9, 1924.

The Disease in Deer.

Since the occurrence of the last outbreak in domestic animals, our efforts have been mainly directed to eradicating foot and mouth disease in the deer of the Stanislaus National Forest, where it gained a foothold as a sequence to the outbreak of this disease among the range cattle in that region. The campaign of eradication of the disease among the deer also has been successfully completed as the date when the last active case of foot and mouth disease was found in these wild animals was June 10, 1925. This outbreak of foot and mouth disease in deer is without precedent in the United States and its suppression after infecting these wild carriers has no counterpart in the history of disease eradication. The campaign of eradication of the disease among the deer was conducted in the Sierra Nevada Mountains, and the difficulties caused by the mountainous territory were increased by divided jurisdiction. The area in which the work was carried on is a national forest under the supervision of the Forest Service of the U. S. Department of Agriculture; part of the campaign work had to be done in Yosemite National Park, which is under the supervision of the National Parks Bureau of the U. S. Department of the Interior. These two services, in addition to the combined regulatory forces of the U. S. Bureau of Animal Industry, State Department of Agriculture, the State Fish and Game Commission, as well as the U. S. Bureau of Biological Survey, made six distinct official agencies vitally interested in the work. Under such circumstances full accord in policy could not always be expected. This became very evident when the work carried the regulatory forces into Yosemite National Park, for at this time the National Parks Bureau was not in agreement with the policy adopted. *It therefore became strikingly evident to the Director of Agriculture that a neutral federal agency, acting in the position of a coordinator, was necessary to bring the official functions together and keep the work running smoothly.* Accordingly, the present Secretary of Agriculture, Hon. W. M. Jardine, was requested to select such an official, and in compliance with this request a member of the Federal Horticultural Board was appointed by the secretary for the purpose mentioned. This appointment was a sound one, for this representative succeeded in coordinating the various official functions and he adjusted other difficulties in a skillful manner. Among the latter was some organized local opposition to this work which, although comparatively small, became sufficiently active on several occasions to require the arrest of offenders who deliberately violated the regulations. Meeting such offenses with any less vigorous official action would have lowered the morale of the field forces, resulting in injury to the work in general.

Origin.

While nothing definite has been uncovered by which it could be determined how the disease gained entrance into California, we feel confident that it has been traced back to the first infected herd, but the

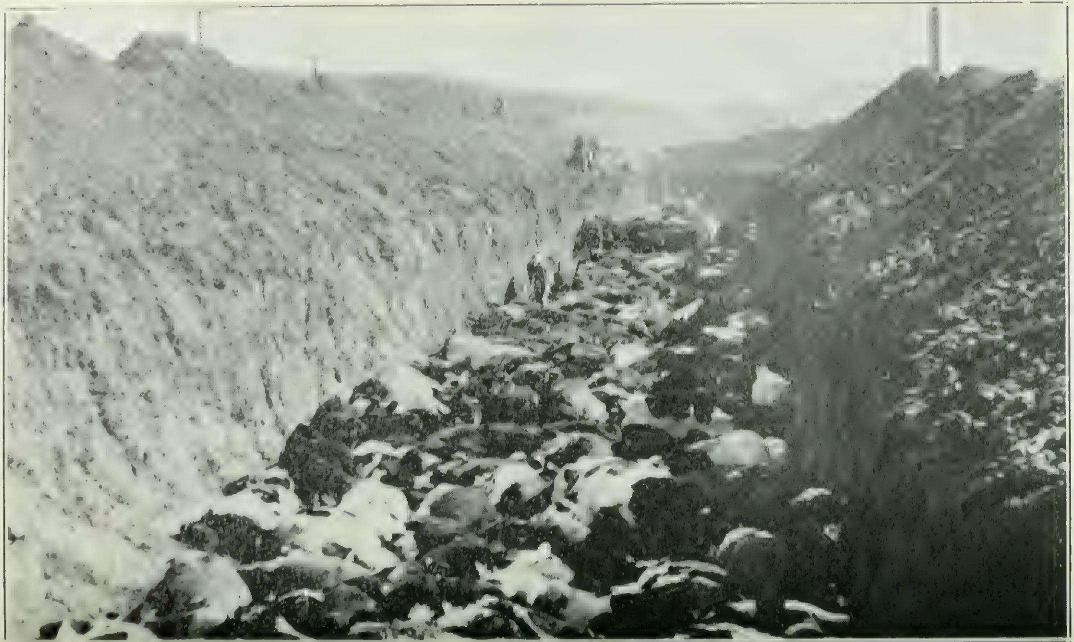


FIG. 2.—Trench containing carcasses of cattle just slaughtered for foot and mouth disease and a few remaining animals awaiting slaughter. Following slaughter the carcasses are eviscerated, covered with quick lime and the trench refilled.

manner of its origin in this herd, while pointing suspiciously to the feeding of contaminated garbage obtained from a vessel of the United States Navy, is still undetermined. This is indeed unfortunate, for with the possibility that the same portal of entry is still open, there is danger of future introductions of this disease which is so prevalent and permanently established in many sections of the world. Orders issued by the Navy to destroy garbage on vessels arriving from foreign ports should have the effect of at least closing this possible avenue.

Summary.

In considering conditions which prevailed when the epidemic appeared in California, we find that the following items of unpreparedness greatly hampered operations toward eradication:

1. Specific legal authority to destroy exposed animals was lacking.
2. Provision for indemnifying persons whose animals and property were destroyed in the course of the campaign was also lacking.
3. The broad quarantine powers necessary to circumscribe such a highly infectious disease were absent, although, under stress of circumstances, they were used with the sanction of public opinion.
4. There was no legal way to prevent the multiplicity of county quarantines that prevented unity of action and caused considerable loss to producers, shippers and others.

Corrective Legislation.

Bearing in mind these severe lessons, remedial legislation was asked for and obtained during the forty-sixth session of the legislature. The most important changes made are the following:

1. The general animal disease control act was amended to give the Director of Agriculture the necessary legal power to cope with outbreaks of foreign destructive infectious diseases of animals should any of them again find a foothold in California. The Director is now legally authorized to slaughter animals which have been exposed to such diseases as to make them potential dangerous disease carriers.
2. Quarantine powers vested in the office of the Director of Agriculture have been strengthened and broadened.
3. Means are provided for appraising animals before slaughter and for legal payment when shared equally by the federal government.
4. A new law was enacted which is intended to prevent a repetition of the multiplicity of unnecessary county quarantines that caused much trouble and damage during the recent epidemic. This law will prevent one political subdivision within the state from placing quarantines against another subdivision because of animal or plant diseases or pests, without the sanction of the Director of Agriculture.

Uniformity of Interstate Quarantines.

An outstanding weakness which became apparent in the early stages of the epizootic was the lack of uniformity in the live stock quarantine systems of the various states evidenced by their desire to act singly rather than in accord with themselves and the federal government. As mentioned elsewhere in this report, this lack of uniformity, particularly during the early stages of the outbreak when the excitement was at its height, proved unnecessarily vexatious and costly to producers and shippers. This is a condition that should be remedied at the earliest possible moment so that in case of another such epizootic in California or elsewhere some uniform quarantine action, free from unnecessary hardships, may be followed by the various states under the leadership of the federal government.

As a constructive remedy for the situation which has existed and which still exists, I submit that the Secretary of the U. S. Department of Agriculture should appoint as collaborators of the federal government the officials in each state having charge of the enforcement of regulatory acts including quarantine, and that a meeting of these officials should be held at least once each year in Washington on the call of the Secretary of Agriculture. This would provide for a clearing house of ideas and would also provide for uniformity in the promulgation and enforcement of regulatory acts. This proposal was favorably recommended to the President by the President's Agricultural Conference and has been endorsed by such national organizations as the American National Livestock Association, National Wool Growers' Association, National Association of Agricultural Commissioners, the National Grange, and others. The advantage and wisdom of contacts such as this plan would provide have been demonstrated through the activities of the Western Plant Quarantine Board. This is an organization of the plant quarantine officers of the eleven western states, British Columbia, Hawaii and the northern district of Lower California, which was formed by the writer at the Fruit Growers' Convention at Riverside in 1919.

A further step in this direction has been taken in the matter of plant quarantine through the formation of regional boards, similar to the Western Plant Quarantine Board, in other sections of the country and the creation of the National Plant Conference Board which is made up of two members from each of the four Regional Plant Quarantine boards. These boards are all working in the closest harmony with the U. S. Department of Agriculture and there is gradually being created a spirit of agreement in the promulgation and enforcement of plant quarantines. This movement has been stimulated by the recent amendment to the Plant Quarantine Act which provides that until the Secretary of Agriculture has acted with respect to a specific insect pest or plant disease, the states have full freedom of action. Once the secretary has acted, however, the states are inhibited from taking action on the particular pest acted on by the secretary in so far as interstate movement is concerned, this of itself preventing unwise and hysterical action by individual states when a state is unfortunately visited by some serious new pest. This same condition should be brought about in animal quarantines and in all other regulatory work of an agricultural nature.

In the report to be issued later I have embodied additional recommendations which I hope will take form at the earliest possible time, but meanwhile we must remember that a successful campaign against any of these animal plagues depends upon the maintenance of efficient forces of trained men in the divisions of the Department of Agriculture —men appointed upon the basis of merit only.

I can not refrain from acknowledging the strong support and cooperation the Department received from the Governor, State Controller, State Board of Control, other state officials, Agricultural Legislative

Committee, University of California, California Development Association, California Dairy Council, farm organizations, Los Angeles chamber of commerce, and others—a list so long that for lack of space all those who helped materially can not be enumerated here. Without this support it is questionable if the fight would have been concluded so speedily and thoroughly. But after all, the major merit of accomplishment belongs to the men in the field, both federal and state, and to the men and women at headquarters, to whom all accord a principal share of the success of this unusual campaign. For many months work proceeded day and night, without pause, no rest or holidays; and to them I take this opportunity of expressing my sincere appreciation for their self-sacrificing services to California and the nation.

FIG. 3.—Rounded up for inspection.

BUREAU OF PLANT QUARANTINE AND PEST CONTROL.

By W. C. Jacobsen, Chief.

During 1925 the work of the Bureau of Plant Quarantine and Pest Control advanced to a new high level, taking into consideration the demands made upon the time of the personnel and the duties they were called upon to perform. Splendid interrelationships between the many functions of the bureau continued to be maintained and harmonious cooperation has prevailed.

As anticipated, there has been an appreciable increase in plant quarantine inspection, due to a greater volume of maritime shipping and an increase in the movement of vehicular traffic through the border quarantine stations, the most striking increase being in the number of automobiles inspected at the border stations; namely, about 125,000 as compared with about 88,000 last year. The pressure at the maritime ports occasioned by the ever-increasing passenger lists of Hawaiian vessels has been offset, to some degree, by more permanent arrangement for additional help. In southern California we have been accorded the privilege of calling upon the horticultural commissioners and their inspectors, to a greater degree than in the past, for assistance at San Pedro, and we have utilized members of the State Department of Agriculture for similar assistance at San Francisco.

A factor which has been of considerable assistance in the enforcement of plant quarantines at the ports has been the issuance of Naval Order No. 147 by the Secretary of the Navy. This naval order has been responsible for a cooperation in the inspection of naval vessels hitherto not received. Better facilities at the ports of San Francisco and San Pedro to take care of the plant products in trade channels which are subject to inspection or treatment at these ports of arrival would be of further aid. Modern, up-to-date plant quarantine inspection stations equipped with fumigation houses, vacuum fumigators and incinerators would assist in more rapid disposition of inspection work.

With the finding of alfalfa weevil in a more extensive area within the State of California, additional problems necessarily arise calling for the extension of the border inspection stations and for demonstrations and help in the control of a new pest. The pressure of additional work at the border stations has, in a measure, been alleviated by the employment of additional inspectors at these points.

Progress in vacuum fumigation has gone forth at a normal rate, new developments continuing to make this mode of treatment more practical and of greater commercial value. The office in charge of this type of work has been called upon to extend its activities into similar fields, particularly as a result of the action of the Federal Horticultural Board in placing certain foreign bulbs on the special permit entry basis. Such action was taken on account of certain bulb pests, some of which are found in California, and has necessitated the close cooperation of the pathologist, the superintendent of nursery service, and the entomologist in charge of special treatments to devise equipment which would be satisfactory for the control of these pests. It has been necessary to augment the information on treating bulbs by vacuum fumigation and to devise proper dipping vats in order to give hot water treatment on account of nematode.

The legislature of 1925 passed an act pertaining to the treatment of picking boxes and orchard appliances, which, in turn, has necessitated the development of procedures in pest control that would adequately cope with the problems this act has been designed to simplify.

New spray materials are constantly appearing on the market; some are of considerable value, others are not so good. The entomological and pathological sections have arranged with the Division of Chemistry for cooperative action to try out these spray materials to learn of their efficacy in the control of insect pests and plant diseases, and also to determine whether or not there is any appreciable injury to foliage or a lasting deleterious effect to the fruit produced upon the sprayed trees. A number of new sprays have been developed because of the special attention accorded to red spider, a pest which has caused increasing damage from year to year, and it is anticipated that some of the sprays recently developed, or which may be developed, will adequately serve to check the damage this pest has caused.

An additional assistant has been added to the entomological staff who has provided needed help along the line of pest surveys and field control information. A temporary assistant has also been added in the field inspection of narcissus bulbs.

In the plant pathological work the effects of educational work among county horticultural commissioners have been noted, better results apparently being obtained in the control of plant diseases and an earlier recognition on the part of the county men of certain of the more serious diseases at a time when effective control practices could be used. Requests for assistance by the pathological service have materially increased to a point where at the present time the force is not fully adequate.

There has been a very marked increase in weed control activities; puncture vine work alone has taken a large portion of the time of the superintendent of weed control. A continuation of the policy of the Department in exterminating the infestations of newly found weeds has continued and intensive work upon some of the more widespread noxious weeds has been carried on. Puncture vine has engaged the attention of the county horticultural commissioners and the State Department of Agriculture to a far greater extent than ever before, and it is expected that in the ensuing year much of the spread of puncture vine will be eliminated. A manifest public interest has aided the department materially in pressing a campaign for the suppression of this serious weed.

Rodent control activities have continued in much the same manner as during the past, consistent and concerted effort on the part of many of the county horticultural commissioners revealing conclusive results at the end of each season. There is, however, much yet to be accomplished, largely due to the spasmodic efforts which are made necessary in the various counties because of lack of funds at the favorable seasons of the year. In certain counties where it has become customary for growers to advise horticultural commissioners of ground squirrel infestations and where it has become rather the rule that it is not good community spirit to tolerate the presence of these rodents, public opinion has effectively assisted the county men in their rodent control campaigns.

Special work was done in Los Angeles County by the horticultural commissioner to affect an eradication on certain areas in the vicinity of the metropolitan area on account of bubonic plague infection which had occurred there. Some real problems in rodent control extermination were encountered and it is interesting to note that actual eradication was accomplished in some of the areas.

There was a change of leadership in the Nursery Inspection Service, made necessary by the resignation of R. D. Hartman. The work of this branch will be carried on along the same lines as previously anticipated, special emphasis being laid upon the control of insect pests and plant diseases which commonly affect nursery stock, such control work to be conducted at the nurseries by the owners. With consistent practice of clean-up methods, some of the work now made necessary at destination by the inspection for insect pests and plant diseases will be eliminated.

There has been a continued expansion in the case of predatory animal control work which, being carried on cooperatively by the Bureau of Plant Quarantine and Pest Control, the U. S. Bureau of Biological Survey and the various counties, has made appreciable inroads into the coyotes that have been causing losses to live stock. Special attacks were made upon notoriously destructive individual coyotes with the result that some of these were either captured or poisoned with the cessation of losses in the immediate vicinity. Very favorable reports were received from some sections, indicating that sheep raising is now a profitable industry, where, previously, it could not be followed at all because of the predatory animal depredations. The staff engaged in predatory animal control extended its cooperation to the eradication of deer in the area under quarantine because of foot and mouth disease. Toward the end of the year this work materially lightened.

The viticulturist carried on some special investigations under a special allocation of funds to determine the effects of the drought of the previous year and of the insect phylloxera on the 1925 grape crop. Weather conditions during the season were particularly noted and the bearing that they had upon the fruiting of the vines, as well as the quality of grapes. This work was carried on in connection with a survey to determine what the approximate car lot movement of grapes for the season would be and to advise those seeking information as to the nature of the grape crop generally.

Exhibits were made at the State Fair and some of the county fairs in conjunction with the general activities of the State Department of Agriculture. The assistant entomologist attached to the office of special regulatory entomology has devoted a considerable portion of his time to the exhibit work in cooperation with the technical assistant of the Department. His activities extended to assisting all of the various bureaus and divisions of the whole Department, and it was found by devoting special and certain time to this feature that satisfactory results could be obtained.

Cooperative work with the office of blister rust of the U. S. Department of Agriculture and the State Board of Forestry was continued to eliminate plantings of black currants in the northern part of the state. The anticipated spread of white pine blister rust in the northwest gradually continued southward and during the season many plantings of black currant, the intermediate host of white pine blister rust, were destroyed. During the year there were 225 plantings, entailing a total of 1415 separate plants, eradicated. There are a few minor holdings yet to be cleaned up in this same area. Roughly, the territory covered is the northern third of California. For the years 1924 and 1925 this brings the total of plantings eradicated to 491, with a total number of 3118 individual plants.

The work of blister rust control, in addition to the actual removal of the bushes, entailed inspection of nurseries, and it is believed at this time that all black currants have been removed from California nurseries. The nurserymen responded very favorably when they were fully informed as to the necessity for preventing the introduction of white pine blister rust, which in itself would menace particularly the sugar pine timber crop of the state.

Careful scouting was conducted to determine the possibility of blister rust having been actually introduced into the state, but at no time were there any indications that it had as yet reached our borders. Educational work in conjunction with the necessity for blister rust control was carried on. It is planned during the following season to extend the work to an area south of the region now covered.

Examinations for county horticultural commissioners and inspectors were taken care of during the year. Inspectors' examinations were held more frequently than anticipated, but, due to a considerable turnover, eligible lists were depleted, necessitating additional examinations. The quality of the candidates for inspectors' examinations shows marked improvement over those who came up for test last year, and there is ample evidence that the value of the examination in standardizing the timber serving as horticultural inspectors has been great.

PLANT QUARANTINE INSPECTION SERVICE.*

MARITIME INSPECTION.

Probably the most important function of the plant quarantine service is the inspection of vessels arriving at California ports from foreign countries and other states. This inspection extends to examination of all plants and plant products, including fruits and vegetables, carried as cargo, in ship's stores, or in the possession of passengers or crew. Examination of the baggage of passengers from foreign countries is carried on by the plant quarantine inspectors in conjunction with United States customs officers. However, the domestic coastwise status of vessels from the Hawaiian Islands exempts them from United States customs inspection and consequently the examination of all passengers' baggage on vessels from that territory is carried on solely by the state plant quarantine inspectors acting as collaborators of the Federal Horticultural Board. Due to the presence of the Mediterranean fruit fly and the melon fly in Hawaii, this baggage inspection represents one of the most important phases of maritime inspection. There are regular passenger vessel sailings between Hawaii and the ports of San Francisco and Los Angeles, with an occasional sailing to San Diego. These vessels frequently carry as high as four hundred passengers, and in the case of large lists our regular force of port inspectors is not sufficient to handle the situation. This has made it frequently necessary to secure assistance from the various horticultural commissioners and from employees in this and other bureaus of the Department. The horticultural commissioners of Los Angeles, Orange and Ventura counties have cooperated by assigning inspectors under their jurisdiction to assist in the Hawaiian baggage inspection at San Pedro, where only six regular state inspectors are maintained and where frequently thirty-five or more are required to efficiently inspect one of these large vessels. Similar cooperation has been frequently given by the horticultural commissioner of San Diego County in the case of vessels arriving at San Diego. The following chart will show a material increase in ship arrivals, together with a consequent increase in passengers and in the number of parcels and shipments of plant products inspected:

---

* By A. C. Fleury, Supervising Quarantine Officer, Sacramento.

Maritime Inspection—All California Ports.

Steamship and baggage inspection—	*1924*	*1925*
Vessels inspected	6.589	6.896
Passengers	52.155	56.651
Horticultural imports—		
Parcels fumigated or otherwise treated	94.484	112.111
Shipments refused admittance	1.478	1.838
Contraband shipments	2.887	1.877
Total parcels horticultural imports	4.269.232	5.570,695
Total shipments horticultural imports	42.706	49,733

One noticeable feature as shown by this chart is the decrease in the number of interceptions of contraband plant products during the year 1925, as compared with 1924. This is undoubtedly the direct result of the hearty cooperation received by the plant quarantine service from the various operators of vessels entering California ports, in requiring strict compliance with the plant quarantine regulations on the part of ship employees and passengers. Many important interceptions of serious pests were made during the year at all ports. Among the more outstanding were a number of interceptions of live larvæ of both the Mediterranean fruit fly and melon fly in fruits and vegetables from Hawaii; gypsy moth egg mass on logs and on plants from Japan; egg mass of Leopard on marble from Italy; European earwig in bulbs from Holland; a serious nut tortrix in chestnuts from Italy; cherry fruit fly in cherries from Oregon; and various serious scale insects, termites, borers, warehouse pests, etc., from all parts of the world, many of which are not established in California.

Naval vessels.

Naval vessels present the same menace as any other ship, since there can be readily carried on such vessels from foreign countries plants, fruits, etc., infested with serious pests in violation of the quarantine regulations. By reason of the ambiguous wording of a naval order, which was intended to give Department of Agriculture inspectors full authority for the examination of naval vessels and an opportunity to pass upon any plant products carried by them, frequent violations of the plant quarantine regulations were encountered and very little cooperation from commanders of naval vessels was received. This condition was particularly evident during the spring of 1925 upon the return of a small part of the Pacific fleet from Hawaii, such serious pests as the Mediterranean fruit fly constantly being intercepted on these vessels. With the greater part of the fleet due to return to California ports from Australia via Hawaii during the early summer, the situation assumed a serious aspect. An appeal by this bureau to the commandants of the Eleventh and Twelfth Naval Districts resulted in securing their cooperation, but, as their authority was limited, no outstanding improvement could be effected, and the Director of Agriculture finally appealed directly to the Secretary of the Navy. As a result of this appeal, a very comprehensive and clear naval order, known as General Order No. 147 and set forth below, was issued by the Honorable Secretary of the Navy, Curtis D. Wilbur:

General Order }
No. 147. }

IMPORTATION OF FRUITS, VEGETABLES AND PLANTS INTO UNITED STATES.

1. General Order No. 90 is hereby canceled and the following substituted therefor:

2. The entry into the United States of certain foreign-grown fruits, vegetables, plants and plant products is controlled by quarantine or other restrictive orders issued by the United States Department of Agriculture to reduce or eliminate the danger of introducing insect pests and plant diseases into this country.

3. Importation in this case is construed as bringing into the waters of the United States, whether actually landed or not, and applies to small quantities as well as large, even to one fruit or vegetable.

4. In order that the regulations of the Department of Agriculture may be fully complied with and no prohibited or infested articles brought into the United States on board naval vessels, it is directed that the commanding officer of a naval vessel or vessels arriving at a United States port from a port outside of the continental limits of the United States (Hawaii and Porto Rico particularly):

(a) Communicate without delay with the commandant of naval district (by radio, if possible, before entering the waters of the United States) regarding the regulations governing the importation of these items and insure that no prohibited fruits or vegetables are on board;

(b) Then report to the commandant of naval district (by radio, if possible, before entering the waters of the United States) what remaining fruits and vegetables taken in foreign ports are on board;

(c) Afford the facilities for and permit of a thorough examination of the ship by inspectors of the Department of Agriculture who may come aboard to determine whether infestation exists on the ship, and carry out directions of such inspectors as to disposition of contraband or infested articles.

5. Commandants of naval districts will keep themselves informed of the regulations and procedure of the Department of Agriculture relative to the subject matter and cooperate to carry out the provisions of this order.

CURTIS D. WILBUR,
Secretary of the Navy.

This order gives full authority for the inspection of naval vessels and requires absolute compliance by the naval personnel with the quarantine regulations. Upon arrival of the fleet during the latter part of September, the effect of this order was apparent in the full cooperation extended quarantine inspectors by the commanders of naval vessels and by the comparatively few violations noted. What might have been a serious situation was thus fully avoided.

Ventura.

Due mainly to the increased production of oil in the Ventura fields, oil tankers from Hawaii and Mexico began to arrive during the year at that port. At the request of this Department, the state quarantine guardian of Ventura County was given federal quarantine authority for the inspection of such vessels, and the interception of fruit fly hosts on tankers from Hawaii has demonstrated the necessity for inspection at this port, which is located in the heart of a large deciduous and citrus fruit growing region.

BORDER INSPECTION.

Border inspection of automobile traffic from the alfalfa weevil infested territories of Nevada and California into other sections of this state, and over the main highways leading from the southern states into the cotton and citrus growing sections of California, was maintained as in the past. The finding of the alfalfa weevil in the extreme southern portion of Lassen County and in the western portion of Plumas County in the spring of 1925 resulted in a quarantine being placed against part of Lassen County and the entire counties of Plumas and Sierra, embargoing the movement of all hay and restricting the movement of other commodities which might carry that insect. This infestation was undoubtedly due to natural flight of the weevil from the infested sections of Nevada, and its presence in those counties necessitated the movement of the northern border quarantine stations to points west of the infested area, as well as the installation of one additional station. During the year 1925 there were inspected 125,542 automobiles at the fourteen border stations maintained that year, as against 88,671 automobiles inspected during 1924. As a matter of scientific record and to illustrate the place the automobile occupies as a factor in the long distance spread of insects, there follows a list of the insects intercepted at all the border stations during 1925 in automobiles and in camping equipment carried in such automobiles, systematically grouped in so far as identification was possible:

	Number specimens intercepted	*Number autos from which taken*
CRUSTACEA		
Oniscidæ		
Porcellio sp.	1	1
CHILOPODA		
Scolopendridæ (?)		
Centipede (undet.)	1	1
ARACHNIDA		
Buthidæ		
Scorpion	5	5
Family (?)		
Solpugid	4	4
Cheliferidæ		
Pseudoscorpion	1	1
Family (?)		
Harvestman	3	3
Ixodidæ		
Dermacentor sp.	3	3
HEXAPODA		
Thysanura		
Machilidæ		
Machilid (undet.)	1	1
Collembola		
Family (?)		
Springtail (undet.)	1	1

	Number specimens intercepted	*Number autos from which taken*
Orthoptera		
Blattidæ		
Periplaneta sp.	1	1
Neuroptera		
Chrysopidæ		
Chrysopid larva	1	1
Myrmeleonidæ		
Ant lion larvæ	2	2
Plecoptera		
Perlidæ		
Perla sp.	1	1
Hemiptera		
Hemipterous nymph (Several species)	11	9
Notonectidæ		
Notonectid (undet.)	1	1
Cydnidæ		
Cydnid (undet.)	2	2
Pentatomidæ		
Pentatomid (undet.)	1	1
Chlorochroa congrua	1	1
Coreidæ		
Coreid (undet.)	1	1
Corizus sp.	1	1
Aradidæ		
Aradus sp.	11	7
Aradus lugubris	6	5
Lygæidæ		
Lygæus kalmii	1	1
Lygæus reclivatus	1	1
Nysius ericæ	7	4
Geocoris sp.	16	11
Neididæ		
Stilt Bug (undet.)	4	4
Reduviidæ		
Reduviid (undet.)	3	3
Triatoma protracta	1	1
Cimicidæ		
Cimex lectularius	54	3
Miridæ		
Mirid (undet.)	10	6
Lygus sp.	2	1
Lygus pratensis	19	9
Membracidæ		
Membracid (undet.)	2	2
Cicadellidæ		
Cicadellid (undet.)	3	3
Coccidæ		
Chrysomphalus aurantii	1	1
Lepidosaphes beckii	1	1
Coleoptera		
Coleoptera (undet.)	42	18
Carabidæ		
Carabids (undet.)	3	3
Calosoma sp.	1	1
Bembedium sp.	2	2
Pterostichus sp.	3	3
Amara sp.	10	8
Calathus sp.	7	3
Harpalus sp.	1	1
Agonoderus sp.	1	1
Gyrinidæ		
Gyrinus sp.	3	1

	Number specimens intercepted	*Number autos from which taken*
Silphidæ		
Silpha sp.	4	4
Staphylinidæ		
Staphylinids (undet.)	2	2
Histeridæ		
Hister sp.	2	2
Saprinus sp.	1	1
Saprinus lugens	3	3
Melyridæ		
Collops sp.	1	1
Trichochrous sp.	2	2
Melyrid (undet.)	3	3
Cleridæ		
Enoclerus sp.	1	1
Trichodes sp.	2	2
Hydnocera sp.	1	1
Meloidæ		
Epicauta maculata	1	1
Anthicidæ		
Anthicid (undet.)	1	1
Notoxus sp.	4	3
Elateridæ		
Elaterid larva	3	3
Cardiophorus sp.	1	1
Anelastes sp.	3	3
Buprestidæ		
Chrysobothris sp.	1	1
Dermestidæ		
Dermestid larva	4	4
Attagenus piceus	1	1
Dermestes vulpinus	2	2
Ostomidæ		
Tenebroides mauritanicus	3	3
Coccinellidæ		
Coccinellid (undet.)	10	8
Ceratomegilla vittigera	3	2
Hippodamia parenthesis	1	1
Hippodamia sp.	1	1
Hippodamia convergens	2	2
Hippodamia sinuata	2	2
Hippodamia 5-signata	1	1
Chilocorus bivulnerus	2	2
Anatis sp.	1	1
Cistelidæ		
Hymenorus sp.	6	6
Cistela opaca	1	1
Tenebrionidæ		
Stenochidus carbonarius	1	1
Tenebrionid (undet.)	8	7
Metoponium faustum	2	1
Nyctoporis sp.	1	1
Eleodes sp.	5	5
Eleodes tricostata	3	3
Coniontis sp.	5	4
Eusattus dubius	1	1
Blapstinus sp.	5	4
Tribolium confusum	1	1
Scarabæidæ		
Scarabæid (undet.)	2	2
Aphodius sp.	3	3
Atænius abditus	1	1
Serica sp.	3	2
Hoplia callipyge	5	5

	Number specimens intercepted	*Number autos from which taken*
Spondylidæ		
Spondylis upiformis	1	1
Cerambycidæ		
Cerambycid (undet.)	1	1
Chrysomelidæ		
Chrysomelid (undet.)	3	3
Diachus sp.	1	1
Phædon sp.	30	4
Trirhabda sp.	2	2
Monoxia sp.	3	3
Luperodes varipes	1	1
Haltica sp.	3	3
Metachroma sp.	1	1
Metachroma californicum	13	1
Bruchidæ		
Bruchid (undet.)	1	1
Bruchus quadrimaculatus	7	1
Curculionidæ		
Snout beetle (undet.)	8	4
Brachyrhinus ovatus	26	18
Sitones sp.	4	2
Sitones hispidulus	6	5
Hypera punctata	1	1
Phytonomus posticus (Alfalfa weevil)	3246	529
Dorytomus sp.	43	13
Dorytomus inæqualis	123	38
Dorytomus cuneatulus	1	1
Magdalis sp.	1	1
Anthonomus sp.	1	1
Cleonus sp.	1	1
Sphenophorus vomerinus	3	3
Scolytidæ		
Dendroctonus, sp.	1	1
Dendroctonus valens	1	1
Trichoptera		
Family (?)		
Caddice fly (undet.)	1	1
Lepidoptera		
Lepidopterous larvæ (Of many species)	70	53
Moths (undet.) (Of many species)	7	5
Pyralididæ		
Ephestia sp.	27	1
Noctuidæ		
Noctuid larvæ	1	1
Heliothis obsoleta	3	3
Hesperiidæ		
Hesperiid (undet.)	1	1
Diptera		
Syrphidæ		
Allograpta sp.	1	1
Drosophilidæ		
Drosophilid (undet.)	2	1
Cordyluridæ		
Cordylurid (undet.)	2	1
Hymenoptera		
Sub-order Symphyta		
Sawfly larva (undet.)	1	1
Superfamily Chalcidoidea		
Chalcis fly (undet.)	2	2
Formicidæ		
Formica sp.	1	1
Camponotus sp.	1	1

A great many of these insects at the time they were intercepted had been carried in the automobile a hundred miles or more and undoubtedly would have been carried at least that much further, or until such time as the camping equipment was again used, if inspection had not been made. While most of these insects were found rolled up with or adhering to the bedding, many were also found under the floor mats in the cars and in crevices behind the seats. Particular attention is directed to the large number of alfalfa weevils (*Phytonomus posticus*) intercepted, as compared with any other species of insect, 3246 being taken from 529 automobiles during the season, as many as 349 being found in the camping equipment carried by one automobile. This well illustrates the important place automobile inspection must take in the scheme of plant quarantine protection. In addition to the many insect interceptions, 5253 lots of contraband plant products, such as cotton seed and other possible carriers of the cotton boll weevil from the southern states; citrus fruits and plants, possible carriers of the citrus canker disease, and other proscribed material, were intercepted in automobiles and destroyed, and 1599 lots of plant products were refused admittance because of insect infestation.

Both the Automobile Club of Southern California and the California State Automobile Association have cooperated during the year by erecting automobile road signs at each of our border stations informing automobile tourists of the presence of the quarantine stations and the necessity for inspection. At our request, the Automobile Club of Southern California also erected at the international boundary of Tijuana signs informing motorists of the restrictions on fruits and plants from Mexico. All of these signs have been of material assistance in the enforcement of quarantine regulations and in securing the cooperation of the traveling public.

INTERIOR INSPECTION.

Plants and plant products arriving in California from other states by freight and express and by parcel post are inspected by the county horticultural commissioners, their deputies and inspectors, acting as state quarantine guardians. During the fiscal year ending June 30, 1925, there were inspected by these state quarantine guardians 33,766 shipments of horticultural material, 270 of these being either destroyed or returned as contraband, and 755 of them being refused admittance because of the presence of insect or disease pests or because of noncompliance with the state quarantine regulations.

Mexican border ports of entry.

Plant quarantine inspection at Mexican border points is under the jurisdiction of the Federal Horticultural Board. The enforcement of quarantine regulations at the two main Mexican ports of entry in California, Mexicali and Tijuana, has been carried on by United States customs officers, no federal quarantine inspectors being on duty at these ports, with the exception that at Mexicali there is stationed a representative of the Federal Horticultural Board. Investigation indicated the necessity for better protection at these ports and at our suggestion two customs officers at Tijuana were appointed collaborators of the Federal Horticultural Board to stimulate their interest in the enforcement of the plant quarantine regulations. The reports received from these collaborators during the year show the interception of forty-two lots of host fruits of the Mexican fruit fly and hundreds of interceptions of other contraband plant material, including 127 lots of avocados in violation of the federal avocado weevil quarantine. This material was all intercepted at the international line in the possession of motorists who had purchased it in Mexico. The situation at these ports of entry is being closely watched and has been brought to the attention of the Federal Horticultural Board. They have agreed to immediately place permanent plant quarantine inspectors at the ports as an additional safeguard.

Disinfection of railway cars.

The disinfection of railway cars contaminated with cotton seed, which is required under the provisions of Regulation 8, Quarantine Order No. 39, has been carried on by the railroads with the use of steam. Complaint by the railroads of the cost of this treatment, together with our own lack of complete satisfaction with the results secured, caused an investigation to determine whether a more satisfactory method could be devised. This investigation was carried on under the supervision of Mr. D. B. Mackie, entomologist of this bureau, and with the cooperation of the Federal Horticultural Board there were made a series of fumigation tests in Texas with live boll weevil in railroad cars. As a result of this investigation, the railroads were informed we would accept in lieu of steam sterilization, fumigation of cotton seed contaminated cars with hydrocyanic acid gas, as this is less expensive and seems a more satisfactory method of disinfection. It is expected that the fumigation recommended with be generally adopted by all the railroads.

Thurberia boll weevil.

The thurberia boll weevil, a variety of the Mexican cotton boll weevil, occurs in the bolls of *Thurberia thespesioides,* a wild cotton plant in Arizona, and has been found on several occasions in cultivated cotton in the vicinity of Tucson, Arizona. A widespread infestation in cultivated cotton occurred in 1920 and again in 1921. During 1922 and 1923, probably because no cotton was grown in the vicinity of the infested district, no infestation was found, but early in 1924, in the still standing 1923 crop, the weevil was again found. Since no infestation was found in either the 1924 or 1925 crop, this Department in the early part of September permitted the importation of cotton seed for milling purposes in limited quantities from the Yuma district of Arizona. However, on October 12, 1925, the thurberia weevil was again found in cultivated cotton, this time in the vicinity of Continental, some thirty miles south of Tucson. This Department immediately canceled all permits and no further importations of cotton seed from Arizona were admitted.

Oriental fruit moth.

On December 24, 1925, the Director of Agriculture, with the approval of the Governor, issued a quarantine order to prevent the introduction into California of a very serious pest, the Oriental fruit moth, *Laspeyresia molesta.* This insect was introduced into the eastern United States a number of years ago on flowering cherry trees from Japan and has since spread alarmingly. It is now known to occur in nineteen eastern and southern states and in the District of Columbia. The Oriental fruit moth seriously affects the twigs as well as the fruits of many of the most important commercially grown fruit crops in California, such as apple, pear, peach, apricot, plum and cherry. Control measures have proved ineffective, due to peculiarities in its feeding habits, and it is readily carried on nursery stock as well as in fruits. Because of the impossibility of detecting the presence of this pest by inspection, all host plants and fruits are, under the provisions of this quarantine, absolutely prohibited admittance into California from those states in which infestation is known to occur.

Chestnut bark disease.

Under date of July 18, 1925, the Director of Agriculture issued a quarantine against the chestnut bark disease, prohibiting the admission of chestnut and chinquapin trees from all states east of the Rocky Mountains. This quarantine was placed because of the insidious nature of this disease and the impossibility of detecting its presence by inspection.

White pine blister rust in Oregon.

On September 23, 1925, this Department was informed by the office of blister rust control of the finding of white pine blister rust on several black currant plants in the vicinity of Pacific City, Tillamook County, Oregon. This is the first record of the occurrence in the state of Oregon of that most serious disease of five-needle pines. Pending quarantine action on the part of the federal government, this Bureau immediately issued a temporary ruling prohibiting the admittance into California of all currants, gooseberries and five-needle pines from the entire state of Oregon. It is expected that the Federal Horticultural Board will take quarantine action in this matter early in 1926, after which this temporary state ruling will be revoked and our present white pine blister rust quarantine will be amended to conform to the federal quarantine.

Alfalfa meal.

As the result of a personal investigation by D. B. Mackie and the supervising quarantine officer at Sacramento of the various alfalfa meal mills in Utah, Idaho, Oregon and Nevada, during December, 1924, the Director of Agriculture on February 25, 1925, amended the alfalfa weevil quarantine to admit alfalfa meal under adequate safeguard measures. These measures provide that the meal will be admitted only from those mills which are approved by the Director of Agriculture as being so operated as to kill during the milling process any weevils which might be present in the hay, and so constructed as to prevent contamination of the milled product. Meal is admitted only during the inactive period of the weevil, November 1st to March 31st. Only four mills have so far been approved by the Director of Agriculture as meeting these requirements.

Sweet potato weevil.

During the year, Quarantine Order No. 35, pertaining to sweet potato weevil, which prohibits the admission into California of sweet potato plants and tubers from those areas in which the insect is known to occur, was amended twice to include additional infested territory in other states. On May 27, 1925, Baldwin County, Alabama, was added, and on December 24, 1925, Jackson County, Oklahoma, George County, Mississippi, and Jefferson County, Alabama, were added.

Citrus white fly.

The Citrus White Fly Quarantine, No. 41, which prohibits the admission into California of host plants of that insect from those states in which it is known to occur, was amended on July 8, 1925, to include Tennessee in the list of infested states.

Cherry fruit fly.

Under date of May 28, 1925, Quarantine Regulation No. 13 was issued by the Director of Agriculture, prohibiting the admission into California of cherry fruits from certain sections of the state of Oregon where the cherry fruit fly is known to occur. This regulation is based upon section 5 of the state quarantine law which prohibits all host fruits of any species of fruit fly from any locality where such species is known to occur, and was issued due to the fact that shipments of cherries from Oregon had been arriving badly infested with live larvae of the cherry fruit fly, *Rhagoletis cingulata*.

Quarantine rulings.

Quarantine rulings were issued during the year prohibiting the entry into California of poplar and willow trees from British Columbia and from that portion of Washington west of the Cascade Mountains, on account of the satin moth, and restricting the entry of potatoes from Washington and Oregon during the summer months, on account of the Colorado potato beetle.

SPECIAL REGULATORY PEST CONTROL.*

The subjects included in this function deal mainly with the application of those pest control methods which affect the mandatory regulation of agricultural commodities in the channels of trade. Such regulation is made necessary by the presence of certain insect pests dangerous to agriculture and horticulture, and pertains in general to treatments or processes to destroy certain species of pests to prevent their further distribution within this state or to other states, and is summed up as follows:

---

* By D. B. Mackie, Entomologist, Sacramento.

1. Treatment and certification of living plant material moving in trade channels.
2. Disinfection of freight cars in connection with boll weevil quarantines.
3. Treatments to eliminate insect pests of bulbs.
4. Treatment of containers to prevent distribution of certain orchard pests.
5. Treatment of California potatoes to meet the regulations of other states.
6. Investigations of eradication methods applicable to citrus white fly.
7. Improvement of vacuum fumigation methods.
8. Miscellaneous.

TREATMENTS FOR LIVING PLANT MATERIAL TO ALLOW ITS MOVEMENT INTO DISTRICTS WHERE OTHERWISE PROHIBITED.

This activity was initiated several years ago in an endeavor to furnish a means whereby certain plants and plant products could be freed of infestations of certain specific insect pests, the presence of which would prevent their movement. Vacuum fumigation has been resorted to more than any other means and its use in some cases is made virtually mandatory.

Numerous economic plants were vacuum fumigated during the past year. The best testimony as to the efficiency of this treatment is a statement in the December, 1925, News Letter of the Arizona Commission of Agriculture and Horticulture by the state entomologist, as follows:

"The survey of the citrus plantings upon the Yuma mesa which was completed prior to the holiday season, indicates that no insect pests or plant diseases are present in that area. The survey was made by Worthington, Eaker, and Smith, field scouts for the Arizona Commission of Agriculture and Horticulture, and was the most thorough that has ever been made. Every tree was gone over and carefully searched for scale insects or any other pests or diseases that might occur. Three weeks were taken up in the survey and 640 acres of trees were inspected."

The first California grown trees were shipped to the Yuma mesa in 1923. During 1925, 7967 trees were vacuum fumigated and certified to by representatives of this department. The above record shows it possible to certify to the elimination of a nominal infestation of various scale insects that otherwise would cause refusal of the shipment.

It is of interest to note the acceptance by county horticultural commissioners of a regulation treatment for citrus nursery stock by vacuum fumigation, which, if properly accomplished and certified to, admits of immediate delivery of same without further restriction. This procedure has been designated under the provisions of Pest Control Ruling "A" of this bureau. This ruling was based on the fact that shipments to the extent of 20,000 citrus trees had been vacuum fumigated at a dosage of 18 cc's of liquid hydrocyanic acid gas at a 27″ vacuum held for 30 days, and upon subsequent inspection showed no living pests. In this case the citrophilus mealybug, *Pseudococcus gahani,* and a number of scale insects, constituted the basis for treatment.

During the year reports from the offices of the county horticultural commissioners show that there were treated in—

Ventura County	42,033	trees
Orange County	10,000	balled
	22,000	seedlings
Los Angeles County	23,118	balled
	38,750	small budded trees and seedlings

A certain block, totaling 111,722 of balled and potted ornamentals treated partly in 1924 and partly in 1925 infested with citrophilus mealybug, and aggregating 112 genera, was fumigated at the so-called 100 per cent schedule or 18 cc's of HCN per 100 cubic feet, held 30 days and reinspected without finding a single living mealybug.

From the results obtained in this case it is believed possible to prescribe a pest control ruling covering certain groups of ornamentals. With such plants as do not fall within this category, the procedure should call for holding 30 days in quarantine after which inspection is again made. Should this inspection show no living specimens the shipment could move to destination.

In the ornamental field the present season's work brings the reported treatment in this group up to an aggregate of 130,308 plants and trees, including 166 genera, not including bulbs. In addition to the foregoing, 10,000 stocks of pecan budwood were treated for infestation with leaf case bearer.

In such a wide range of plants some injury is to be expected. It may be said without fear of contradiction that such injury as occurred was in a much lesser degree than expected, particularly when the season was considered. A large part of this work with ornamentals was done in the summer with plants in full growing condition. In some cases anticipated injury failed to materialize. In other cases some injury was manifest in different lots of the same species treated in the same load.

There is need for a better understanding of certain factors which influence the fumigation equation. Some have been identified and knowledge of these has contributed greatly to fumigation efficiency and also to reduction of injury. These are the load factors, and spraying with water immediately after treatment.

Vacuum fumigation is not a cure-all for it has been forcefully brought out that fumigants have their limitations. It is inadvisable to attempt the treatment of certain plants, even though the same pests might be killed if present on other hosts. This group includes such plants as staghorn fern, asparagus sprengeri in wire baskets, fern balls, and Kentia palms infested with *Rhizoecus falcifer.* In these cases the insect is often protected in such a manner that the gas is vitiated before it reaches the pest. A host index of such plants is in the process of preparation.

With the close of the present shipping season it is believed that sufficient data will be available to permit the department to set forth the pests attacking all types of nursery stock that may be destroyed by this method and the procedure to be followed with each.

DISINFECTION OF FREIGHT CARS.

The treatment of all freight cars fouled with cotton seed to destroy possible infestation of boll weevil has been mandatory. Heretofore this method has been accomplished by the steaming of the cars for four hours. These regulations and the detailing of inspectors to spot all such cars placed somewhat of a burden upon the railroads. This bureau was asked if an alternative were not available. In June, 1925, this work was assigned to the writer for investigation. In checking the steaming practices, a recording thermometer was placed within cars being steamed; this showed that up to six cars a 165° F. was recorded. As more cars were coupled in the temperature declined to 120° F., showing that the steaming equipment was sometimes loaded beyond capacity.

It is asserted that steam is costly and the treatment involves long hauls, switching and often barging. Also, the cars are left wet, which prevents immediate reloading.

Tests were conducted with hydrocyanic acid fumigation. Certain of the old cars of "the Chicago roof type" as well as those of more modern construction were used. It was found that 2 pounds of liquid hydrocyanic acid gave a lethal dosage covering a period of 2 hours, which yielded in an ordinary closed freight car 100 per cent kill to certain of the common storage pests such as saw-tooth grain beetle and the red-legged ham beetle.

With this as a basis the Federal Horticultural Board was requested to repeat these experiments using the adult boll weevil to check the kill. This was done at Brownsville, Texas, by a member of the board's staff who reported as follows:

"There were thirteen fumigations where the liquid gas was used at the rate of 1 ounce of the liquid gas per 100 cubic feet of fumigation space. In these tests 875 boll weevils were used and all were killed, giving a 100 per cent kill in every case. There was but one test where ¾ ounce of the liquid gas was used per 100 cubic feet of space and inasmuch as a 100 per cent kill was not obtained in the initial case, no further tests were made. There were two fumigations made with sodium cyanide solution. In each case this solution was used at the rate of 2 ounces of sodium cyanide per 100 cubic feet of space. One hundred twenty-four insects (boll weevil) were used and all killed."

At the dosage employed in the experiments a 1½ ounce or its equivalent dosage of 54 cc's per 100 cubic feet of space was utilized, thus giving a high safety factor.

In summarizing the data obtained in these investigations, there is no doubt that disinfection of freight cars by steam can be made highly efficient, yet the use of liquid hydrocyanic acid furnishes a 50 per cent added safety factor over what is necessary to kill the boll weevil. Seed fouled cars could be treated at convenient points without entailing the long hauls to established steam plants, and at less cost. The real menace is from cars fouled with cotton seed originating in the cotton belt and then loaded with other commodities.

TREATMENTS TO ELIMINATE INSECT PESTS OF BULBS.

The following constitutes the résumé of different bulb pests which have come to our notice:

Merodon equestris (greater bulb fly).
Eumerus strigatus (lesser bulb fly).
Rhizoglyphus hyacinthi (bulb mite).
Anuraphis (Myzus) tulipae (tulip aphis).
Lothrips vaneeckei (lily thrips).

Merodon equestris.

This bulb fly is frequently taken by inspectors at quarantine in shipments of foreign narcissi, and in locally grown material. We have found it on the following species:

Narcissus;
N. Tazetta, Paper White and Polyanthus varieties;
N. poeticus, Poets' Narcissus;
N. pseudo-narcissus, Trumpet Narcissus group;
N. poetaz, hybrid-tazetta x poeticus; and
N. jonquilla, Jonquil.

On narcissus groups we have observed it on bulbs from a number of points ranging from San Diego to Humboldt. It seems to be more prevalent in the Trumpet group, but is found also on polyanthus. A preponderance of the latter group, in blocks of commercial plantings, may cause it to multiply in injurious numbers. During 1925 it has been taken on Paper White, Soliel d'Or and Chinese Sacred lilies, species on which it is not supposed to occur, according to bulb growers.

In the iris group it has been observed over a period of three years, being taken on the following species:

Iris xiphium, Spanish Iris;
Iris xiphium x tingitana, Dutch Iris;
Iris tingitana, French Iris.

In 1922, the average infestation ran twenty-five per cent in a lot of about 1,000 bulbs of permit material, part being lesser bulb fly. A lot of 4,000 Iris tingitana showed only about four per cent infestation.

Observations force us to conclude that the larvae of Merodon enter the bulb through the bottom and not through the neck of the bulbs, as seems to be the common belief. This conclusion has been reached after cutting hundreds of bulbs of both iris and narcissus. The larvae pupates in the ground closely adjacent to the bulb.

One bulb growing concern treated all bulbs last year by vacuum fumigation, using carbon bisulfid, and reports a complete kill of this species. This year they dug nearly 1,000,000 bulbs before finding a single infestation.

In 1923 the average infestation of both bulb flies in the holdings of this company was around ten per cent. This season it did not reach one per cent.

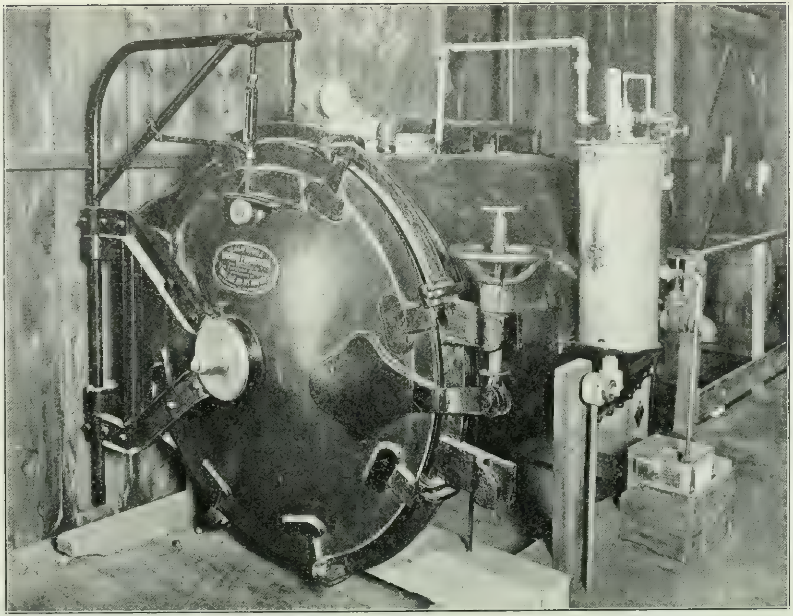


FIG. 4.—Vacuum fumigator of a size which is readily adaptable for treating narcissus bulbs or other hosts of bulb flies, mites, and tulip aphis and bulb thrip. Successful treatment by vacuum fumigation has proven this method beyond the experimental stage. By proper handling bulbs can be treated in sacks, thus providing against reinfestation by bulb flies.

Eumerus strigatus.

This fly is much more numerous than the former species and its hosts include a vastly wider range than the greater bulb fly. The records of this office show it to have been taken on the following:

Narcissus tazetta;
Narcissus poeticus;
Narcissus Poetaz;
Narcissus pseudo-narcissus;
Narcissus jonquilla;
Iris xiphium, Spanish Iris;
Iris xiphium x tingitana, Dutch Iris;
Iris tingitana, French Iris;
Iris pogoniris, German Iris;
Iris susiana, Mourning Iris;
Lilium auratum, Golden Banded Lily;
Lilium candidum, Madonna Lily;
Amaryllis, spp. Amaryllis;
Hyacinthus orientalis, Common Hyacinth;
Calla elliottiana, Yellow Calla;[1]
Gladioli, spp. Gladiolus.

There are a number of other hosts of this species but we have not observed them. We have found more on the Trumpet narcissus group than on any other, although it is very numerous on some of the bulbous iris, being more prevalent on this variety than is generally believed.

The species has been reared from both local and foreign plants and materials containing larvae of this pest have been received in Humboldt, Marin, San Francisco, Alameda, Sacramento, Los Angeles and San Diego counties. Its presence on members of the genus Lilium was noted July, 1923, in Monterey County. It is less common in hyacinth than in narcissus, although about ten per cent of the hyacinths in Capitol Park, Sacramento, are annually destroyed by it. This year, 1925, limited digging in a planting in Santa Cruz County showed that one bulb in every four of Golden Spur, King Alfred and Van Waveren Giant varieties of narcissus carried larvae of this fly. We believe that the Elliot Calla and the different species of the genus Lilium are only casual hosts.

This fly lays its eggs on the bulb,[2] and judging from the number of larvae found in a bulb, often reducing it to a decayed shell, the number of eggs varies considerably. Seventy-six is the maximum number of individual larvae observed in one bulb of the variety Golden Spur. These pupate within the remains of the bulb as a genearl rule, unless it is reduced to a rotten mass, when they sometimes pupate among the outside scales. As stated previously, the status of this pest is a point on which all interested parties are not agreed. One group holds that it is a scavenger, another that it is a primary feeder. The former belief seems to have been engendered by failure to effect a transfer of larvae to sound, healthy bulbs. It is our belief that this pest is primary and that it is the greatest menace to bulb culture occur-

---

[1] Reported by Mr. Ronald Hunt, County Horticultural Commissioner, Santa Cruz.
[2] Observation made by Bureau of Entomology.

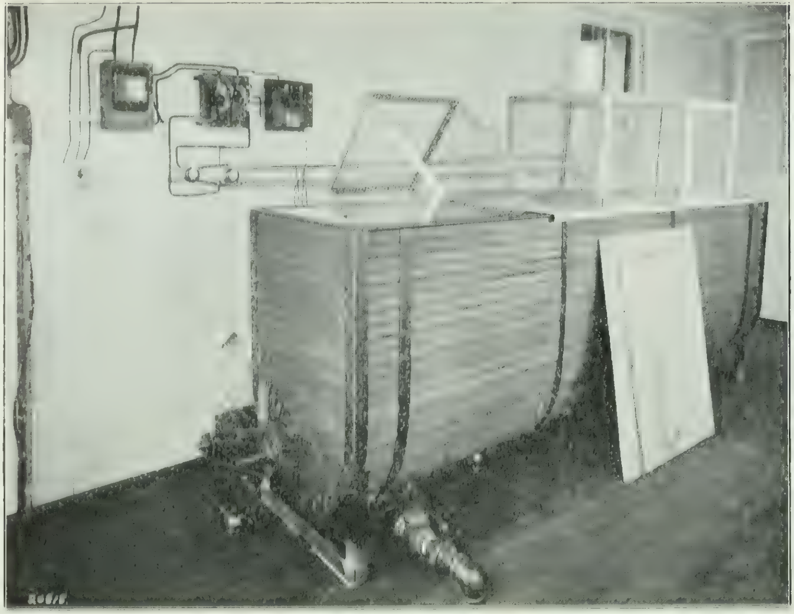


FIG. 5.—Electrically heated, thermostatically controlled, hot water dipping vat of high efficiency for treating bulbs. This type of vat meets all requirements of state and federal government for treating narcissus bulbs. Developed by the entomologist, Bureau of Plant Quarantine and Pest Control, California Department of Agriculture.

ring at present in the State of California. This is based on the following observations:

Sound bulbs are found with only young larvae in them. These will be found in the upper end of the tunnel entering from the bottom where a large number are present. Bulbs have been noted with the outer scales intact and undecayed, the center stems and a few of the inner scales or core in the same condition, while the remainder was reduced to a rotting, spongy mass, due to the feeding of a large number of larvae. This species is rarely found singly, but generally in considerable numbers, which rapidly reduce the large portion of the bulb to a state of decay by cutting through the scales and leaving a mass of detached tissue. The larvae seem to be able to exist in considerable slime without great inconvenience. It has been noted that where a bulb is not slimy and rotted, pupation will take place in the interior. If wet, the larvae crawls to the outside scales and upwards, finding such location more congenial.

In the bulbous iris they work in much the same manner, with fewer larvae per bulb, probably due to its smaller size. In observing infestations, the bottom of the bulb is always examined. Often bulbs do not show infestation by a feeling of softness and hollowness, but the presence of the fly can be determined by the entrance cavities.

In the genus *Lilium*, the larvae tunnel through the scales near the stem, in each case being found at the upper end of the tunnel.

Rhizoglyphus hyacinthi.

This species has been taken generally in a wide range of bulbous plants. We have found mites on all of the foregoing. To these might be added gladiolus, potato, *Calla ethiopia*, freesia, tulip, hollyhock and *Calladium esculentum*. Of particular interest is their work in the genus *Lilium*, where they were noted operating both in the bulb scales and in the stems. In the latter they occurred in colonies tunneling out the entire center. In the scales they occurred as individuals, each adult mite working in, forming a minute pocket wherein it feeds, giving the infested bulb a somewhat peppered appearance. These observations were made on *Lilium candidum* in Monterey County, July 29, 1923.

Where the infestation was noted on hollyhock, the larvae were found tunneling in the stem of a well developed plant which had bloomed. This observation was made in July, 1925, on specimens sent to the State Insectary at Sacramento for identification.

The case of infestation on gladioli was found at Alhambra in June, 1925. About sixty per cent of a yard planting was completely destroyed.[1]

In the case where the pest was found on potato, tubers of that species were sent in by one of the inspectors in Kern County, in December, 1922.

This pest has been noted wherever bulbs are grown in the state, and appears to pass from one host to another where different species of bulbs are stored or sold, as in seedhouses, flower shops, etc. In the field it seems to reach its most destructive proportions in the places where the bulbs are not taken up during the summer.

---

[1] Reported by A. O. Larson, U. S. Bureau of Entomology.

Anuraphis tulipae.

This species was first noted in January, 1923, on tulip bulbs from Holland, identification being made by the U. S. Bureau of Entomology at Washington. It has since been noted as a general feeder and has been found infesting iris, both bulbous and rhizome types, gladioli, anemone, and tulip. The infestation seems to be heavy on bulbous iris in storage and particularly numerous on narcissus. We have taken it in Sacramento, Santa Cruz, Monterey and Los Angeles counties.

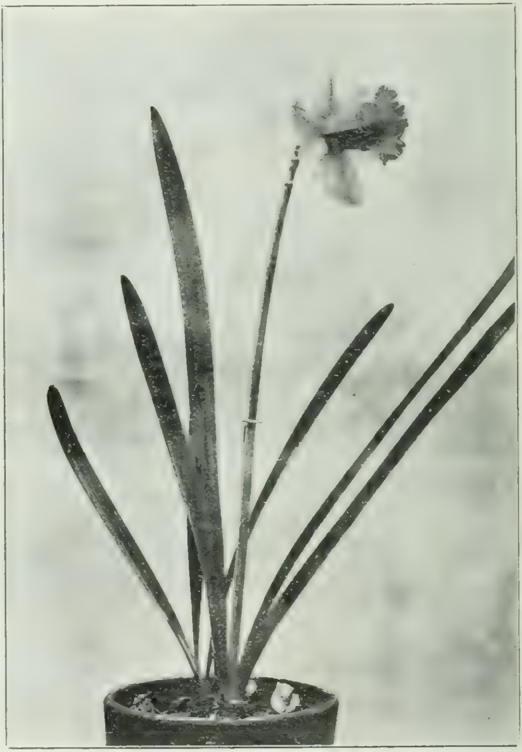


FIG. 6.—Emperor narcissus grown from bulb subjected to vacuum fumigation with carbon bisulphide, 3 pounds per 100 cubic feet of fumigator space, for 2 hours at 27-inch vacuum. Bulb forced for bloom, with no indication of injury.

Liothrips vaneeckei.

This species has been called to our attention only once and does not appear to be generally distributed in the state. Identification was made by specialists of the Bureau of Entomology.

CONTROL MEASURES IN CONNECTION WITH BULB PESTS.

This office, in connection with its fumigation projects, took up the work of fumigation of bulbs in 1922. Both the gases of hydrocyanic acid and carbon bisulfid were tried out, mainly with a view to finding out the resistance of the various bulbs to them. As a result we have been forced to discontinue the use of hydrocyanic acid for all pests except tulip aphis and bulb thrips. Fumigation to destroy both flies and mites must be for a period of not less than two hours. Bulbs must be thoroughly dormant, free from packing material, and packed in a manner which allows for proper ventilation after fumigation. The time of treatment in California is about July or early August. Due to the fact that sprouting of both roots and buds has taken place in arriving foreign bulbs, treatment, while possible, is considered somewhat dangerous. No work has been done in attempting methods of field control, all methods being used on cured bulbs in storage.

The California Department of Agriculture has pointed out ways in which bulb pests can be controlled and has supplied demonstrating equipment for this purpose. The results obtained have been very satisfactory. Some of the larger growers of bulbs have undertaken the treatment and are obtaining good results; others have not taken the required care.

With hydrocyanic acid at atmospheric pressure, successful fumigation has been accomplished against both aphis and thrips. In fact, several fumigation boxes have been constructed by bulb growers.

Since the advent of the nematode we have been forced to revise our methods in order to adapt them to the control of this species. As matters stand the present treatment calls for immersion in hot water at 110° F., for approximately three hours. In regard to bulb flies, it is our belief that this treatment can perhaps be modified to effect control of both insects and acarid pests at one time. Necessary vats have been designed and constructed which are capable of adjustment to any desired temperature. Vacuum fumigators have been constructed and have been in operation for three years.

The California Department of Agriculture has listed the host plants of each species and developed the necessary treatment. Any ruling which anticipates the destruction of the fly in commercial material moving intercounty or interstate will have to include all narcissus varieties and all bulbous iris.

Treatment according to present data available for control of either bulb fly would offer the alternative of vacuum fumigation for $1\frac{3}{4}$ hours with dosage of 3 pounds of carbon bisulfid per 100 cubic feet in a 27″ vacuum or of dipping at a temperature of 110° F. for $2\frac{1}{2}$ to 3 hours for narcissus, with iris treatment limited to vacuum fumigation.

At this writing there will be available for bulb pest treatments, 8 dipping vats and 3 vacuum fumigators. It is believed this equipment will be able to handle a large part of the work, also that the conditions which have been developed during the year completely justify the action begun by this office three years ago.

TREATMENT OF CONTAINERS TO PREVENT DISTRIBUTION OF CERTAIN ORCHARD PESTS.

It has been recognized that empty picking boxes and certain other containers act as vehicles for the transportation of certain insect pests. In 1920 an attempt was made to reduce this hazard in the distribution of mealybugs by the development of mechanical devices whereby empties could be sterilized with steam before being returned to clean orchards.

At that time the areas under infestation were not extensive enough to arouse the sentiment necessary to a proper appreciation of the dangers and the need for preventative measures. While one or two citrus packing houses constructed sterilizers and certain canneries steamed boxes more for cleaning than for pest control purposes, nothing final was done. With the spread of mealybug to some of the grape and pear districts there has come about a greater realization of the possible damage, in so far as no satisfactory method has been found for the field treatment of infested plants. Practically all new infestations show up in the immediate vicinity of piles of empty boxes, giving evidence of the part played by the container in the distribution of this pest.

It appears that with the past season's losses it will be possible to regulate the movement of these commodities with the assurance of success. The mechanical failures of the problem have been worked out and arrangement has been made with the Canners' League for the cooperation of the canneries.

Another field where the treatment of containers is resorted to is in the treatment of empty sacks to destroy the hibernating larvae of the walnut codling moth. Vacuum fumigation is used, being accomplished with a mixture of carbon disulfid and carbon dioxide. In all, eight fumigators are in operation, owned by packing houses in the Walnut Growers Association.

TREATMENT OF POTATOES TO MEET REGULATIONS OF OTHER STATES.

In connection with the movement of potatoes from California to other points in the Rocky Mountain and Pacific states, it is interesting to note that certified vacuum fumigated potatoes are now admitted to all states which are members of the Western Plant Quarantine Board. In January, 1925, Idaho amended her quarantine, which heretofore prohibited the entry of California potatoes on account of this pest.

Due to the low prices prevailing on this commodity few cars went out of California, only about seven carloads in all being certified and fumigated.

INVESTIGATION OF ERADICATION METHODS APPLICABLE TO CITRUS WHITE FLY.

Legislative action for the purpose of eradicating citrus white fly has made necessary the consideration of all possible measures to secure defoliation of the various host plants. Opportunity for the use of a large number of citrus trees was afforded by courtesy of J. B. McFarland, manager of the Nimbus Ranch, near Sacramento.

In these experiments hydrocyanic acid was tested at strengths from 100 to 300 schedules, also in conjunction with Bordeaux mixture and with sulphate of copper solutions (the work being conducted in the daytime). In addition there were used certain strengths of a commercial weed killer. No complete foliage drop was secured in any case, though with the weed killer a certain amount of the sprayed foliage was killed but did not fall. While these results were not unexpected, it is necessary to have concrete evidence.

IMPROVEMENT IN VACUUM FUMIGATION METHODS.

Work with the development of a nonexplosive gas mixture using a combination of gases carbon disulfid and carbon dioxide, has been brought to a successful commercial use. It is now possible to handle the fumigant and at the same time have any gases that may arise from the carbon disulfid so mixed with carbon dioxide that the chance of ignition is exceedingly remote. However, additional safeguards have been installed in the way of explosion heads ample to ease the force of any chance explosion without wrecking the apparatus. Mechanical improvements have made it possible to salvage about 80 per cent of the fumigant, which materially cuts the cost of operation.

With the close of this year all of the larger equipment plants and practically all of the smaller outfits have been converted to this method of fumigation. During the year the pack of the California Almond Growers, the California Peach and Fig Growers, the picked meats of the California Walnut Growers, and four date packing houses, have been processed by this fumigant.

There were fumigated with hydrocyanic acid commercial material the following:

Walnut meats	75,550 lbs.
Chili peppers (dried)	122 sacks
Dog biscuit	50 cases
Raisins	19,340 lbs.
Apricots (dried)	300 lbs.
Figs	66 cases
Dried shrimp	5 barrels
Black figs	18,600 lbs.
Cotton seed	18,370 lbs.
Dates	1,250 lbs.
Package rolled oats	7,139 lbs.
Dried squash	7 carloads
Hardwood panelling	1 bundle
Poultry food	1,000 lbs.
Pancake flour	511 tons

MISCELLANEOUS.

The usual amount of miscellaneous work occupied a portion of the time. In this connection designs and specifications were furnished for vacuum fumigator and equipment for the Protectorate of Morocco. The same was furnished to the entomologist of the United Province of India. As collaborator of the U. S. Bureau of Entomology, a paper was prepared on the use of the combination gases in vacuum fumigation. Data on bulb pests and treatment were prepared for the Federal Horticultural Board, as was material for use by this department in the hearing held by the Secretary of Agriculture in regard to the exclusion of narcissus and other bulbs.

CONCLUSION.

It is believed the work of the year demonstrates that the protection of a number of our agricultural industries can be greatly enhanced by the development of better methods of treatment to prevent certain commodities acting as vehicles for the transportation of insect pests which are known to take a heavy toll wherever they have become established. In certain fields the work has progressed to the point where the department is justified in concluding that certain positive results are already an accomplished fact.

GENERAL ENTOMOLOGY.*

The activities of this section covers the general problems of orchard and field insect pest control. In this work our main efforts are directed along the following lines:

(1) Carrying on eradication measures to prevent new insect pests from becoming more widely established within the state.

(2) Preventing further spread of injurious insect pests which are known only in definite localities or in certain limited portions of the state.

(3) Conducting control measures especially directed against pests having some bearing upon different phases of the enforcement of agricultural laws.

(4) Making field tests of commercial insecticides to determine their effectiveness in insect pest control and for possibility of injury to fruits, trees or ornamental plants.

(5) Aiding fruit growers and farmers in the control of pests which might become sources of danger to the community or state, and which might render agricultural products unmarketable.

(6) Aiding county horticultural commissioners in all phases of insect pest control with which they may be concerned in conjunction with the enforcement of agricultural laws.

(7) Maintaining a reference collection of insects of economic importance, the same being used in securing determinations of different species with which field and office work is concerned.

Soluble Sulphur Spray Burn.

At the request of peach growers to determine the cause of spray burn upon peach trees from the use of lime sulphur and soda sulphur compounds used in the spring spraying, investigations were immediately undertaken to determine the cause of the injury. With the aid of the Division of Chemistry in making analyses of the spray materials used, and finding that the products were standard in composition, the following conclusions were reached: (1) that the dormant applications of these soluble sulphur solutions were applied when the blossoms were actually opening and too late for the dormant spray applications, (2) that the most severe injury was found on orchards which had been irrigated late in the season and which had developed large quantities of late, tender growth, (3) that most of the burning resulted where trees were sprayed after drying winds and late in the evening or early in the morning. Under these conditions the soluble sulphur solutions remained on the twigs in liquid form sufficiently long to be absorbed and result in burning. (4) Trees which were sprayed before blossoms and leaf buds opened and in the hours of the day when the sprays would dry rapidly showed little or no burning.

---

*By T. D. Urbahns, Field Entomologist, Sacramento.

Commercial Spray Oils.

Various field tests were made with commercial spray oils to determine their efficiency. Much attention was given to the testing of oil emulsions sold as special refined oil emulsions for summer spraying. During the present season only two of these were in general use throughout the state. Four other brands were used more or less in an experimental way by the respective manufacturers in different localities. Field tests have definitely shown that safe summer oil emulsions are of unquestionable value in the control of common red spider and certain other orchard mites, as well as some insects attacking ornamental plants. The effect of these oil sprays upon such fruits as plums, figs and peaches, which are to be sold on the fresh fruit markets, must still be determined by field tests. Since other summer spray oils are being developed, further tests will be necessary to determine their degree of safety to foliage, as well as their effectiveness against pests for which they are recommended.

Common Red Spider (*Tetranychus telarius* Linn).

The common red spider developed very rapidly after the middle of June and before the close of the season caused considerable loss to agricultural crops. The prunes, peaches, plums, figs, pears, beans, apples and almonds were most severely attacked. The first infestations were late and general red spider injury was not anticipated.

Field tests with various commercial insecticides clearly demonstrated that oil emulsions prepared with special refined oils were effective against the eggs and molt stages of these mites as well as against the active forms.

Only one brand of special summer oil emulsion was available for general use throughout the state; four other brands were used in certain localities more or less in an experimental way for red spider control.

The various oil emulsions intended for summer spraying may be prepared from oils of differing grades of refinement or from blends of two or more types of oil. It is therefore to be expected that variable results will follow. Our field tests show that different summer oils vary with regard to their effect upon the trees sprayed as well as with regard to their control of orchard mites. Such differences become more complicated by the greatly varying climatic condition between the coast sections and those of the interior valleys. The great range in types of trees or fruits to be sprayed must likewise be carefully considered. Under these conditions much work must still be done with the so-called summer spray oils before general recommendations in red spider control can be made. Special refined oil emulsions have, however, filled a great need in orchard mite control. With the stabilizing of definite standard products which may be considered as safe summer oil emulsions, their use will be far-reaching in the field of mite and insect pest control.

Sugar Content of Oil Sprayed Prunes.

Complaints were received concerning the late ripening of prunes sprayed with summer spray oils and led to preliminary studies to determine if these oil sprays were detrimental to the quality of the fruit. Samples of fruit from sprayed and unsprayed orchards were secured, and sugar tests were made by members of the Division of Chemistry. The average sugar test for French prunes from thirteen orchards sprayed with summer spray oil showed 44.99 per cent sugar at 22 per cent water content. The same variety from seventeen unsprayed orchards showed an average of 44.39 per cent sugar at 22 per cent water content. Most of the oil-sprayed trees held their foliage and continued to grow later than the infested unsprayed trees.

Citrophilus Mealybug (*Pseudococcus gahani* Green).

Among the mealybugs, which group is fast becoming of great economic importance in this state, this species is now one of the leading citrus pests and is costing growers in the southern and coast counties large sums of money in its control. Spraying and fumigation against this pest have been replaced by liberation of natural enemies as well as controlling the argentine ants which protect the mealybugs against natural enemies. This species is of importance as a pest on ornamental plants in nurseries, and together with other species it is now causing nurserymen much concern. Thorough applications of summer oil emulsions are of great value in keeping the pest in check on such plants.

Grape and Pear Mealybug (*Pseudococcus maritimus* Ehrh.).

This mealybug is known to grape growers as the grape mealybug, and is known to pear growers as the pear mealybug. It continues to be a pest in certain vineyards of the leading grape districts in the San Joaquin and lower Sacramento Valleys. Control measures in the way of dormant and delayed dormant spraying with oil emulsions are practical with only partial success. Spray injury to vines and inability to reach the egg masses or active insects under the bark render such control measures somewhat questionable. Some of the older infestations in the Fresno grape district were apparently brought under partial control by natural enemies, either native or introduced. Special interest in this mealybug is now centered in the Lodi grape district. The presence of the mealybugs and honeydew secreted by them is a serious defect upon the fruit of the grape. Infested fruit is rejected from shipment under standard grades by fruit inspectors. In the Sacramento River pear district, the San Francisco Bay district and the Santa Clara Valley it is becoming of greater economic importance as a pest on pears. Infestations on pear trees must be under good control before the fruit gets well sized, or the mealybugs find their way into the calyx end of the pear. The honeydew secreted becomes objectionable by the time the fruit ripens and the presence of both bugs and honeydew interferes with the marketing of the fruit to the best advantage of the grower.

Pear Leaf Rust Mite (*Epitrimerus pyri*).

Pear growers experienced considerable russeting of the fruit in some of the older orchards in various districts. Inspection showed the presence of pear leaf rust mite on the fruit as well as upon leaves in Mendocino, Sonoma, Lake, Solano and Sacramento counties. Field observations indicated that more thorough spraying with lime sulphur liquid, 4 gallons, or dry, 8 to 10 pounds, in 100 gallons of water, in the cluster bud stage should be practiced. Such an application, when thoroughly applied, should give effective results against the rust mite and blister mite as well as being of value in scab control. While the affected fruit is not seriously injured as to quality by this russeting, it shows in marked contrast to the normal fruit at the time of picking and packing for shipment.

Codling Moth (*Carpocapsa pomonella* Linn).

Larvae of the codling moth were taken in Kelsey plums found to be infested in Fresno County. The plums were grown near infested apple trees. In the apple districts the codling larvae again rendered quantities of fruit unfit for market, the infestations being most severe on orchards not receiving personal supervision by the owners with regard to spraying and orchard sanitation. Carefully sprayed orchards in most districts suffered only a small per cent of fruit loss by this pest.

In the pear orchards this pest is more easily controlled and losses are less severe. One very thorough application of arsenate of lead as a calyx spray, followed by from two to four early cover sprays, are urged in order to assure marketable fruit. Tree banding with burlap to collect larvae is advised in badly infested orchards. Especial care should be given in the application of the late cover sprays to avoid the excessive spray residue which may result in the rejection of fruit on public markets. Proper early spraying will obviate the necessity of the objectionable late sprayings.

The codling moth attacking English walnuts continues to spread through the southern and coast counties walnut districts. Control measures are both difficult and costly where trees are large. Basic arsenate of lead is necessary to prevent burning of foliage.

European Earwig (*Forficula auricularia* Linn).

A recent survey as to the distribution of this insect showed the present infestation extending from the Albany district, north of Berkeley, through the business district of Berkeley and as far to the south as Nineteenth street in Oakland.

Adults and nymphs were present in large numbers on vacant lots where they spent the summer months in the deep cracks of the heavy black soils. In back yards they apparently preferred hiding under boards or old trash such as rags or sacks. With the approach of cool and damp weather the earwigs seek shelter in buildings and become a pest in the home. This species has proven to be a pest of flowers in our present infestation, but just what it will do as an agricultural pest has not been demonstrated under California conditions. The following is quoted from Professor B. B. Fulton, Seventeenth Biennial Report, Oregon Board of Horticulture.

"Earwigs are decidedly general feeders and have very good appetites. They eat the leaves, flowers and fruits of a great variety of plants and meat is devoured greedily whenever they are fortunate enough to get it. Nearly all garden vegetables are more or less subject to attack by earwigs. The bean is one of their favorite food plants, and I have seen potato plants as thoroughly defoliated by earwigs as if the Colorado potato beetle had done the work. They eat numerous holes in the leaves of fruit trees and berry bushes."

The habits of this insect are such that it may be readily carried to new localities. Some of the most likely ways of spread are in garbage, bedding, fruit crates or boxes, upholstered furniture, packing of nursery stock and in balled or potted plants.

Elm Leaf Beetle (*Galerucella xanthomelaena* Schrank).

The elm leaf beetle, first known to be present in this state in June, 1924, has multiplied with exceptional rapidity. The natural spread extended to the south and southeast in direct line with prevailing winds. The general infestation covers Fresno, Tulare and Kings counties, with traces of infestation found in Madera and Merced counties to the north.

In rural districts, where special equipment is not available for the spraying of high shade trees, the elms suffered severely from defoliation and many beautiful specimens were killed. Control measures carried out by the city and county of Fresno gave very effective results with two thorough applications of lead arsenate. The city of Visalia sprayed practically all of the elm trees as a precautionary measure against the scattered general infestation making its appearance. Hanford and Tulare have made arrangements to take up the control work.

The elm leaf beetle is not primarily an agricultural pest, except in so far as shade trees are of great value and importance on the farmstead and on the highways of hot interior valleys of California. With the elm leaf beetle now established in California, considerable thought should be given to the selection of shade trees for rural planting and, as far as possible, the planting of elms should be avoided on account of the added burden of spraying for leaf beetle control.

Alfalfa Weevil (*Phytonomus posticus* Gyll.).

Among the leading pest control problems with which California is confronted, the control of the alfalfa weevil has an important place. Field studies during June and July of this season showed a spread of this pest along the eastern borders of the state, which now extends into three counties. Infested fields were found in the Sierra Valley in Plumas and Sierra counties and extending to the north in Long Valley from the California-Nevada state line to a point six miles north of Doyle Station.

The Honey Lake Valley is connected with the present infestation by a chain of small alfalfa fields. These fields are, from one to another, within the range of weevil flight so that the Honey Lake district, with its 17,000 acres of alfalfa, is endangered by infestation from this source. Every effort was made to interest alfalfa growers in the infested areas in weevil control methods. Field cultural methods and the use of arsenical sprays were urged. The low yield per acre in the districts now infested, as a result of drought and the short growing season, seriously interferes with securing the interest and cooperation of many of the ranches.

Diabrotica Beetles (*Diabrotica soror* Lec.).

Adult beetles of this species were unusually abundant in late June and July, attacking ripe apricots and early peaches. Their numbers were likewise noticeable in bean, melon and truck crop fields, where considerable injury to plants resulted. The prevalence of these beetles was probably in part due to the late rains coming in June which were especially favorable to development of the larvae.

Western Leaf-footed Plant Bug (*Leptoglossus zonatus* Dall.).

This plant bug made its appearance in the Imperial Valley in pomegranate and grapefruit orchards in numbers sufficient to cause damage to the crop. The punctured fruit was followed by decay. Reports from the county commissioner of horticulture indicated favorable control from the use of calcium cyanide dust.

Fig Scale (*Lepidosaphes ficus*).

The fig scale, for a number of years confined to a comparatively small area east of Fresno, is spreading to other plantings. There is urgent need of special field work with regard to control measures and possible checking of further spread of this pest. The possible spread of the fig scale through the distribution of the Mammie figs for the introduction of the fig wasp, needs careful consideration.

The Grasshopper Situation.

Agricultural crops probably suffered less from grasshopper attacks during 1925 than during any season for the past ten years. This may be accounted for in part by the large quantities of grasshopper poisons which have been used throughout the state annually for the past seven or eight years; native grasses were kept growing by late spring rains and supplied grasshoppers with feed in the foothill districts, thereby preventing their migration to orchards and other cultivated areas.

PLANT PATHOLOGY.*

During the year approximately twelve hundred specimens of plants and plant parts were received and diagnosed for diseases. Specimens were sent by horticultural commissioners, various agricultural agencies, growers, shippers of fruits and vegetables, and nurserymen.

In young deciduous fruit trees directly from nurseries, those diseases which were most commonly found were crown gall (Bacterium tumefaciens), root-knot (Heterodera radicicola), oak-fungus rot (armillaria mellea), brown rot (pythiacystis citrophthora) and blight (coryneum beijerinckii). Among the diseases of rather uncommon occurrence were black heart (Verticillium albo-atrum) on apricot roots, root rot (cause unknown) on olive and hairy root (Bacterium tumefaciens) on cherry and apple. In addition, there have been many cases of secondary root rots following cultural disturbances and mechanical injuries. From the abundance in which the aforementioned diseases were found, it is apparent that a large number of trees are condemned annually by inspectors.

Among the diseases which occurred in orchards, vineyards and fields of small berries, there were several which were injurious and are not endemic in the state. A brown rot of the flower and fruit stem of the grape, caused by Botrytis cinerea, was very common and injurious in several parts of the state. Ring mildew on grape (cause unknown) was by far more common than usual. Brown rot (Sclerotinia cinerea), gray mold (Botrytis cinerea) and blight (Bacillus amylovorus) on cherry were very destructive in 1925 in certain districts. There is an apparent necessity for the application of control measures for these diseases. In the case of brown rot of cherry, spraying with 4-4-50 Bordeaux mixture in January is now being advocated. While this method of control is still in the experimental stage, it is hoped that hold-over cankers on twigs can be controlled.

---

*By D. G. Milbrath, Plant Pathologist, Sacramento.

In a survey of the principal crops in the state, the following estimate of losses due to diseases was made:

Crop	Disease	Cause	Per cent Loss
Apple	Blight	Bacillus amylovorus	0.5
	Bitter rot	Unknown	3.0
	Scab	Venturia pomi	1.0
	Powdery mildew	Podosphaera leucotricha	2.0
Almond	Brown rot	Sclerotinia cinerea	1.0
	Rust	Puccinia pruni-spinosae	0.1
Apricot	Green fruit rot	Sclerotinia libertiana	0.5
	Brown rot	Sclerotinia cinerea	5.0
	Shot-hole	Coryneum beijerinckii	6.0
Asparagus	Rust	Puccinia asparagi	2.0
Barley	Stripe	Helminthosporium gremineum	5.0
	Stem rust	Puccinia graminis	3.0
Beans (dry)	Root rot	Rhizoctonia and Fusarium	2.0
	Powdery mildew	Erysiphe polygoni	tr.
	Root-knot	Heterodera radicicola	2.0
	Wilt (Blackeye beans)	Fusarium sp.	7.0
	Mosaic	Unknown	1.0
Beans (green)	Rust	Uromyces appendiculatus	8.0
	Mosaic (Kentucky Wonder)	Unknown	3.0
	Mildew	Erysiphe polygoni	1.0
Cantaloupe	Downy mildew	Plasmopara cubensis	2.0
	Powdery mildew	Erysiphe cichoracearum	15.0
Celery	Foot rot	Sclerotinia libertiana	0.5
	Black heart	Unknown	0.1
	Late blight	Septoria petroselini	2.0
	Mosaic	Unknown	tr.
Cherry	Brown rot	Sclerotinia cinerea	10.0
	Gray mold	Botrytis cinerea	20.0
Garlic	Nematode	Tylenchus dipsaci	5.0
Grapes	Nematode	Heterodera radicicola	0.5
	Brown rot	Botrytis cinerea	0.5
	Black mildew	Unknown	0.5
Lettuce	Drop	Sclerotinia libertiana	0.5
	Brown rot	Unknown	5.0
	Tip burn	Climatic	1.0
	Downy mildew	Bremia lactucae	2.0
Onion	Pink root	Fusarium sp.	0.5
	Downy mildew	Peronospora schleideniana	15.0
Oats	Crown rust	Puccinia coronata	1.0
	Stem rust	Puccinia graminis	3.5
	Halo and blight	Bacterium coronafaciens	0.5
Pear	Blight	Bacillus amylovorus	16.0
	Scab	Venturia pyrina	3.0
	Black end	Unknown	0.5
Peach	Blight	Coryneum beijerinckii	3.0
	Rust	Puccinia pruni-spinosae	0.5
	Leaf Curl	Exoascus deformans	1.0
Potato	Leak	Rhizopus and pythium	0.3
	Black leg	Bacillus atrosepticus	tr.
	Late blight	Phytophthora infestans	0.1
	Internal browning	Unknown	4.0
	Heat necrosis	Unknown	0.5
	Net necrosis	Unknown	0.5
	Nematode	Heterodera radicicola	5.0
	Wilt	Fusarium oxysporum	2.0
	Wilt	Verticillium albo-atrum	0.5
	Scab	Actinomyces scabies	0.2
	Leaf roll	Unknown	6.0
	Mosaic	Unknown	3.0
	Rhizoctoniose	Rhizoctonia	3.0
	Black heart	Physiological	0.1
	Armillaria rot	Armillaria mellea	tr.
Sugar Beet	Curly top	Unknown	15.0
	Nematode	Heterodera Schachtii	5.0
	Nematode	Heterodera radicicola	2.0
Sweet Potato	Stem rot	Fusarium sp.	2.0
	Black rot	Sphaeronema fimbriatum	2.0
	Storage rots	Rhizopus sp., etc.	4.0
Tomato	Soft rot	Rhizopus nigricans	0.5
	Puff	Unknown	2.0
	Blossom end rot	Unknown	1.0
	Leaf spot	Macrosporium sp.	tr.
	Mosaic	Unknown	4.0
	Nematode	Heterodera radicicola	5.0
	Western blight	Unknown	25.0
	Wilt	Fusarium lycospersici	0.5
	Wilt	Verticillium albo-atrum	0.5

From the data presented above, it is apparent that climatic conditions were exceedingly favorable for the development of several very injurious diseases. Among the field and truck crops, rust on asparagus, Western yellow blight on tomato and powdery mildew on cantaloupe caused considerable losses during the year. While in the aggregate the loss of asparagus was not great, nevertheless individual fields suffered largely. As shown in the table on crop losses due to diseases, the total loss in asparagus due to rust was estimated as 2 per cent. The losses in tomato due to Western yellow blight were estimated as 25 per cent and in cantaloupe, due to powdery mildew, as 15 per cent. The plant pathologists of the department were called upon frequently during the past season for information and advice on control of these diseases. The control measure for rust advocated on asparagus was sulphur dusting or planting of resistant stock; for Western yellow blight on tomato cultural methods as deep planting and cultivation were advised; and for powdery mildew on cantaloupe no specific remedy could be recommended unreservedly on account of lack of experimental data.

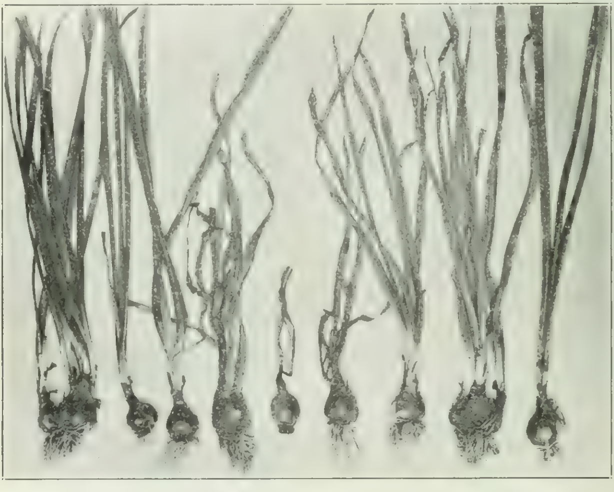


FIG. 7.—Effect on adjacent bulbs, bulb by bulb, nematode infestation incurred by planting one diseased bulb. Nematode infestation has spread to four bulbs on either side in the same row during one season's growth.

In conjunction with the plant pathology department of the University of California a survey was made of fields of strawberry plants in Shasta County to determine the amount and distribution of yellows disease. A request had been made by the Strawberry Growers Association for inspection and certification of young plants on the basis of freedom from this disease, but on account of its wide distribution in the fields it was decided to postpone such inspection and certification.

Investigations of chestnut canker caused by Fusicoccum sp. were continued for the purpose of determining the distribution of the disease and parasitism of the fungus.

Investigations of the cause of overgrowths on the roots of Diospyrus were carried on to determine whether Bacterium tumefaciens is the cause. So far as these investigations have been conducted evidence leads to the conclusion that the three species commonly used (D. lotus, D. kaki and D. virginiana) are highly susceptible to crown gall.

Investigations of onion seed were started at the request of the analyst of the seed laboratory. The purpose of the investigations is to determine whether or not any pathological conditions are contributing to the low germination of onion seed.

In conjunction with the chemist of the department a plan was formulated for the testing of questionable spray materials in orchards. The work of testing one of these materials has been begun on an extensive scale.

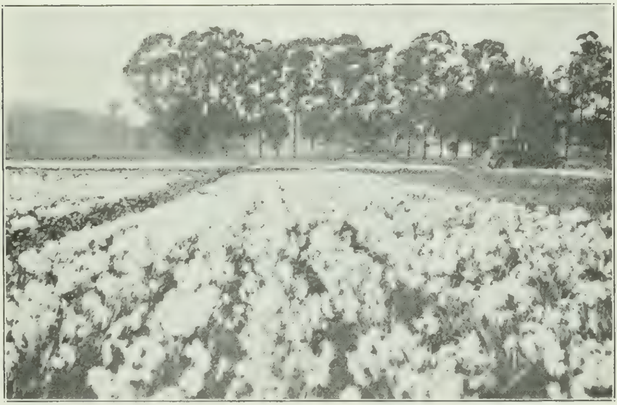


FIG. 8.—Field of two-year old paper white narcissus in full bloom, Santa Cruz County.

In December one week was devoted to inspection of nursery stock in the United States Plant Introduction Gardens. During the year 1925 specimens of plant materials were received from the quarantine inspectors at San Francisco for diagnosis. Among these specimens two cases of citrus canker on pomelo from China were found. This work was performed under a collaboratorship with the Federal Horticulaural Board.

In 1925, Tylenchus dipsaci was found, for the first time, in garlic in the field. Upon discovery of this disease, surveys of all garlic fields in San Benito and Monterey counties were made by the horticultural commissioners of these counties and regulatory measures enforced by them to prevent its spread. Advisory and scientific assistance was given to the commissioners in this work by the plant pathologists of the department.

The hot water method of control of Tylenchus dipsaci in narcissus bulbs was applied experimentally to infested garlic bulbs. Small lots of bulbs were treated for periods of 2, 3 and 5 hours to ascertain the effect of the treatment on the tissues and growing qualities of the cloves. After treatment the bulbs were broken into cloves, which were then planted out into open soil at Sacramento. From the results of this meager test, it is apparent that the growing quality of the cloves is impaired, although all cloves from treated bulbs sprouted regardless of length of treatment. Further tests must be made before definite conclusions can be formed.

The survey of alfalfa fields was continued to ascertain the amount of infestation by and distribution of Tylenchus dipsaci. Thus far, infestations have been found in Humboldt, Santa Cruz, San Benito, Monterey and San Bernardino counties.

Progress Report on Studies Relating to the Control of Tylenchus Dipsaci in Narcissus.[1]

Tylenchus dipsaci was first discovered in narcissus in California in May, 1923. At that time infestations were found in fields near Eureka and McKinleyville in Humboldt County and in fields near Santa Cruz in Santa Cruz County. Later, in April, 1924, in a survey of all commercial narcissus fields in the state, other infestations were found in Alameda County.

How long prior to these dates these infestations had been in narcissus in Humboldt and Santa Cruz counties is a matter of conjecture. 'A quite acceptable conclusion on the probable period of the introduction of the nematode in narcissus in California can be drawn from conditions in Alameda County, where the oldest commercial plantings in the state were found. In that county the narcissus industry has been confined entirely to flower production and, in consequence, the bulbs have not usually been disturbed by digging periodically. In some fields, according to reports of owners, it was found that the bulbs had not been disturbed for periods ranging from 9 to 18 years. Such fields were usually found free from infestation, except in cases where the plantings had become contaminated by additions of infested bulbs during the past four or five years. If the history of the introduction of the nematode in narcissus in the other counties of the state runs parallel with the age of the industry, then it is very likely that the nematode was introduced recently.

That the infestations in narcissus in the commercial bulb districts of Europe have accumulated and increased only in recent years, appears evident through the beginning of intensive investigations at as late a date as 1917.

Ritzema Bos[2] reported in 1915 that no definite results had been obtained in experiments with hot water treatment. Hot air treatment was then given considerable attention by van Slogteren,[1] but was later abandoned and the hot water method adopted. In 1920, van Slogteren[2] published his results of three years' experience with the disease. By that time van Slogteren accepted the hot water method, but fully realized the many difficulties to be encountered in regard to the reaction of bulbs to the exposure.

---

[1] The treatments of bulbs and field investigations, recorded in this report, were carried out by C. E. Scott, Assistant Plant Pathologist.

[2] Bos, Ritzema. Report on researches made and advice given during year 1915 by the Institute for Phytopathology at Wageningen, in Meded Landbouwhooggeschool, Wageningen, vol. XVI, 1919. Abst. in Rev. Applied Entomology, 1919, p. 443.

In England, it was not until 1917[3] that it was recognized that Tylenchus dipsaci was entirely responsible for the disease. At this time, Ramsbottom,[4] working at Wisley, undertook to develop the hot water treatment. Following his experiments, this sterilizing method was gradually accepted as a part of the routine in narcissus culture, and by 1923 a large capacity apparatus was commercially available. In this method infested bulbs were immersed in water at 110° F. for a period of 2 to 3 hours, the larger bulbs receiving the longer treatment.

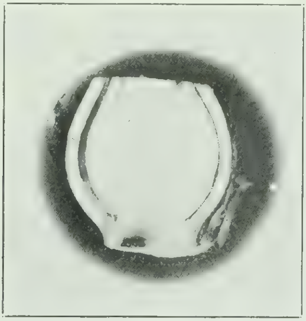


FIG. 9.—Darkened portion of bulb shows brown ring caused by nematode, Tylenchus dipsaci, infestation.

Following the experiences of these countries, the office of Plant Pathology of the California State Department of Agriculture began a series of tests of the hot water method to ascertain its efficiency under California conditions and methods of bulb culture.

The first test was made in September, 1923, and the results of this test were published, in part, in an article by C. E. Scott in Phytopathology, vol. 14, pages 495-502, 1924. From the results of this test it was believed that the method was efficient and it was concluded that there were other factors besides temperature of the water and duration of the treatment that required consideration. Such factors as condition of the bulb as to dryness, cure and age could not be ignored.

---

[1] Van Slogteren, E. De Toepassing van Warmte als Bestrijdingsmiddel van eenige Bloembollenziekten, in Weekblad voor Bloembollcult, August 19, 1919.

[2] Van Slogteren, E. De Nematoden-Bestrijding in de Bloembollenstreek, in Tijdschrift over Pflantenziekten, vol. XXVI, 1920.

[3] Welsford, E. J. Investigations of the Bulb Rot of Narcissus, in The Annals of Applied Biology, vol. IV, pp. 36-46, Sept. 1917.

[4] Ramsbottom, J. K. Investigations on the Narcissus Disease, in Jour. Royal Hort. Soc., XLIII, May, 1918. Also later articles by the same author in Jour. Royal Hort. Soc. and The Gardeners Chronicle.

In 1924, two tests were carried out on a much larger scale with bulbs grown and handled commercially at Santa Cruz. In the particular lot of bulbs selected for these tests the disease was so serious than even the grower realized he was facing a total loss of his stock in one or two years. Experiments of the previous year had warned us of the difficulties to be encountered, so that considerable care was given to these tests in the effort to save as much of the stock as possible.

The first lot was treated on June 29, 30 and July 1, 1924. The bulbs of this lot had been dug on June 27 and 28, thus allowing only a few days between lifting from the ground and treatment. At this period the flower tissues were in the earliest stages of development. Approximately 22,000 bulbs of Soleil d'Or and 13,000 bulbs of Barrii conspicuus were treated by immersion in water at an uniformly maintained temperature of 110° F. for a period of three hours. After treatment the bulbs were laid out on a wood floor, where they were allowed to drain off and dry for a period of forty-eight hours. They were then placed in sacks and stored under ordinary shed conditions at Santa Cruz until September 15, when they were planted on land which, according to the best information obtainable at that time, had not been planted previously to bulbs. Neither alfalfa nor garlic, the two other economic hosts found in California, were known to have been planted on this land for a long period of years.

The untreated bulbs which were used as checks consisted (1) of one lot of about 11,200 bulbs which had been left undisturbed at digging time in the original and infested land, and (2) of another lot of about 11,200 bulbs which had been dug and planted without previous treatment in the new land and adjacent to the treated bulbs. Both lots used as checks belonged to the variety Soleil d'Or. Unfortunately, no untreated bulbs of the variety Barrii conspicuus were planted or remained in the original field.

The second test was begun on September 7, 8 and 9, when about 15,000 bulbs of Soleil d'Or were treated in separate lots and for different periods. These lots were immersed in hot water at 110° F. for periods of two, three, four and seven hours. The bulbs had been grown in the same land as those of the first test, but had not been dug until August 15. After treatment they were spread out and allowed to drain off and dry for 48 hours, then placed in sacks and stored until September 15, when they were planted in the new land and adjacent to the treated lots of the first test. The untreated bulbs of the first test served also as checks of the second test.

During the growing season the fields were visited and the plants were examined at four different periods of their development. Examinations were made of the leaves and flower stalks to ascertain the presence and amount of infestation. Observations were made pertaining to the effect of the treatment upon the growth and flowering qualities of the bulbs. From the data collected the following summary can be presented.

1. Approximately 90 per cent of the plants of the treated lots of bulbs of both tests were free from infestation. The estimated 10 per cent infestation was localized in spots in the field.

2. Approximately 100 per cent of the plants of the two check plats were severely infested. At the end of the season the bulbs of these plats were considered a total loss.

3. The amount of flowering of the plants from the treated bulbs of both tests was very small in comparison with the normal flowering tendencies of the two varieties. There was appreciably less flowering in Soleil d'Or than in Barrii conspicuus, and the plants from the untreated bulbs, in spite of the severe infestations, produced flowers more freely than those of the treated bulbs.

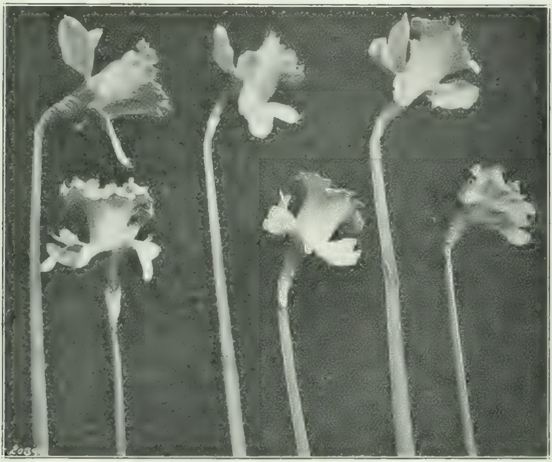


FIG. 10.—King Alfred narcissus blooms showing injury after standard hot water treatment, due to improper handling and improper curing before such treatment.

4. In the lots of bulbs treated on September 7, 8 and 9, for periods of two, three, four and seven hours, no differences were apparent as to the effect of treatment on the nematode and bulbs.

5. No differences between the plants of the July and September treated bulbs could be detected with respect to the nematode destruction and effect on the flowering quality.

The great difference in amount of infestation between the plants of the treated and untreated bulbs points toward the effectiveness of the hot water treatment. That complete eradication was not obtained can not be accounted for definitely. The treating vat used was an electrically heated and controlled apparatus, which worked accurately and maintained constantly the required temperature. In view of the localization of the infestations in the field, there are several probabilities of error such as unknown infestations in the soil before planting or accidental additions of untreated bulbs during storage or planting.

The greater amount of flower production in the plants of untreated bulbs over those of treated bulbs leads to the conclusion that the flowering quality of the treated bulbs was impaired and that those bulbs would not have been suitable for forcing purposes. The difference in amount of flower production between Soleil d'Or and Barrii conspicuus points toward a possible difference between the varieties of narcissus in their reactions to the treatment.

In 1925, about 46,000 bulbs were taken at random from the stock of Soleil d'Or which had been treated in 1924 and which flowered sparsely, after planting, and were again subjected to the standard treatment. The bulbs were dug on September 1, and treated on September 8, 1925. When the plants from these bulbs were examined on February 5, 1926, the foliage was not far enough advanced for an efficient examination for nematodes. At that date, as the grower was picking and shipping an abundance of flowers of excellent quality, evidently the second treatment of the bulbs did not affect the flowering powers in the same degree as the first treatment in the previous year. In 1924, the bulbs had been treated on June 29, 30 and July 1, and in 1925, they were treated on September 8, about ten weeks later. Undoubtedly, the condition of the bulbs at time of treatment in each case was a determining factor in the reaction with respect to flowering. In later examinations of this field no nematode infestations were found.

On November 23, 1925, a lot of 63,000 French grown Paper White bulbs was received for propagation at Watsonville. These were found infested upon arrival and treatment was recommended. The standard treatment was applied immediately and the bulbs were planted directly after. As a check on the treatment, about 500 bulbs were left untreated and were planted in the same field and adjacent to the treated stock. When examined on February 5, 1926, there was found a marked retardation of foliage development in the plants from the treated bulbs in comparison with the checks. The foliage at that time showed good color but was very short. The roots were well developed from all points on the root plate. There were no apparent "misses" in the rows indicating probable bulb destruction by the late treatment. The reduction in amount of flower production was very noticeable and the flower crop for that season was a commercial failure. In this case the results indicate injury of the flowering qualities of the bulbs by the late treatment. The propagation power of these bulbs was also somewhat impaired.

Another lot of French grown Paper White arrived at Santa Cruz on December 23, 1925, and on account of the lateness of arrival, treatment of the bulbs was not attempted, with exception of three sacks which were treated for experimental purposes. These showed the following conditions:

First sack—bulbs of all sizes showing well advanced roots.

Second sack—bulbs were 11-17 cm. in size showing no roots.

Third sack—bulbs were 14-15 cm. in size showing no roots.

These bulbs were treated and planted shortly after arrival. When examined on February 5, 1926, the plants from the untreated bulbs were found in heavy bloom. Only one living bulb was found in the three test lots which had received hot water treatment, most of the treated ones being in a decaying condition. The results of this test point to the possibility of severe injury to bulbs treated late in the season.

The efficiency of hot water treatment in the destruction of the nematode in bulbs was given further tests in 1925 by growers under the supervision and direction of C. E. Scott of this office. The following results of these tests are presented:

A. About 150,000 Paper White bulbs planted in 1923 became so severely infested and subsequently injured, that in 1925 the stock had decreased to about 75,000. Under healthy conditions there should have been, with the two years' increase, at least 500,000 bulbs. In 1925 the salvaged bulbs were given the standard treatment and planted in new land. During the growing season the plants were inspected very carefully on several trips to the field, but no infestations were found.

B. At the same time and in the same field as in Case A., 10,000 Empress, 5000 Soleil d'Or and 5000 King Alfred bulbs were planted which had been severely infested and had received the standard treatment. During several careful inspections no infestations were found in the plants produced by these bulbs.

C. About 100,000 Paper White bulbs which were so severely infested that great losses would have occurred were treated and planted on new land. The treatment consisted of immersion for 3 hours in water at 110° to 111° F. temperature. No infestations were found during the growing season.

From the results of experiments such as have been mentioned the following conclusions can be drawn. The hot water method can be recommended as an efficient means of eradicating the nematode from narcissus bulbs. The date of treatment appears limited, it being inadvisable to treat bulbs later than October. Bulbs treated can not always be depended upon for commercial flower production in the first season after treatment. The efficiency of the treatment is dependent upon the efficiency of the operation of the apparatus as much as upon the apparatus itself.

RODENT CONTROL.*

Rodent control activities have continued along lines of an established program followed during the past several years, the horticultural commissioners of the various counties being in charge of the regulatory work and the representatives of this department assisting them with their individual problems.

In cooperation with the U. S. Biological Survey a number of experiments were held to determine the efficiency of different gases and poisons on rodents. These experiments were held in several localities to check the results under different climatic conditions.

The year 1925 showed a substantial increase in the amount of material handled and acreage treated by county horticultural commissioners; approximately 1,147,389 pounds of poisoned grain were sold at cost, two-thirds of which was mixed and distributed under the supervision of the county officials. This poisoned grain was used to treat 4,003,121 acres of range and cultivated lands at an average cost of about ten cents per acre. During the winter and spring the commissioners used 662,880 pounds of carbon bisulphide and 3,699,300 waste balls, treating about 750,000 acres of agricultural lands at a cost of approximately $1.15 per acre. The use of calcium cyanide showed an increase during the year, 31,120 pounds having been handled by the county horticultural officers.

---

* By Norman G. Buhn, Superintendent of Rodent Control.

In cooperation with the horticultural commissioners a number of gopher control demonstrations were held in various sections of the state. Approved methods of handling poison and traps were demonstrated with the result of a marked increase of materials used.

As in the past years, community squirrel drives were held in the northeastern sections of the state supervised by representatives of the department. This method of control has proved very beneficial to land owners, having been the means of holding the Oregon ground squirrels under control in that more sparsely settled section of the state.

The cooperative arrangement with the Biological Survey was continued during the year. Mr. Joseph Keyes was in charge of the Survey work and devoted most of his time to poison operations on government lands within the state.

PREDATORY ANIMAL CONTROL.*

Predatory animal control work in California during 1925 has been carried on normally and with a steady growth. Requests to expand our activities have come about from reports of an appreciable diminution in losses to live stock where the work has been conducted. Generally speaking, the counties increased their appropriations set aside for cooperation with the state and federal governments. The type of work conducted, namely, trapping and poisoning in areas where there has been marked damage to live stock and game, has spread from an unintended concentration in the northern part of the state until now it covers virtually the entire area, although some of the southern sections at the present time do not have as complete protection in predatory animal control as others. This is largely due to the inability of state and federal funds to be farther extended and to the fact that the particular sections in question have not seen fit to provide cooperation locally.

The following counties are now cooperating, with the approximate appropriation for predatory animal control herewith listed:

Alameda	$1,750	Kern	$4,140
Contra Costa	1,000	Lake	2,000
Glenn	1,000	Lassen	1,320
Humboldt	4,881	Mendocino	8,000
Sacramento	1,000	Tulare	1,000
San Joaquin	1,000	Yolo	2,000
Sonoma	2,500	Yuba	1,500
Tehama	800	Monterey	3,000
Modoc	1,000	Napa	2,500
Nevada Wool Gro.	720	Imperial	235

---

* Joint Report—W. C. Jacobsen, Chief, Bureau Plant Quarantine and Pest Control, State Dept. of Agriculture, and Chas. G. Poole, Leader, Predatory Animal Control Work, U. S. Biological Survey.

In addition to the above counties cooperation has been extended to live stock associations and communities in San Diego, Imperial, Colusa, San Mateo and Sutter counties. Some intensive work has been done in Siskiyou, Mono and Trinity counties, with slightly less intensive work in San Bernardino and Los Angeles counties. In Santa Barbara and Ventura counties demonstrational work has been conducted at the request of live stock associations.

The total number of predatory animals reported during the fiscal year 1925 was 4370. This number represents those actually caught in trap or found as a result of poisoning operations. It will be remembered that the practice in predatory animal work, in so far as poisoning is used, is to exert very little effort in attempting to find poisoned coyotes which may have wandered considerable distances from the stations where poison has been exposed.

There was some slight interruption in the general program occasioned by the detailing of certain of the employees to the Stanislaus National Forest. The men detailed to this particular task were picked because of their familiarity with the habits of deer and of their long experience in control methods for wild animal pests. The live stock interests and the county boards of supervisors who were cooperating were, with minor exception, fully in accord with the transfer of predatory animal experts to the foot and mouth work, realizing that the service of these men would be of very marked benefit in preventing the possible spread of the disease in their sections of the state.

Some opposition has been encountered from bounty and fur trappers but the success of the work in cutting down losses to live stock has been so overwhelming that the vital agricultural industries having to do with cattle and sheep in the state have been able to deal very effectively in overcoming the opposition.

Special attention has been paid to prevent any undue or unnecessary killing of true fur bearers. We have refrained from doing intensive work in certain areas because of the possibility of killing skunks and some of the fur-bearing mammals. This policy has not been followed, however, when definite knowledge of damage to live stock and game has been reported.

Appreciable cooperation has been forthcoming from the various wool growers and live stock associations and from the Fish and Game officials of the state. Their full understanding of the problems confronting us in predatory animal control has aided materially in carrying the work into sections where previously it was not conducted.

No actual outbreaks of rabies have been found to exist during the year. Reports of rabies in isolated sections were received, resulting in prompt investigation of the circumstances. No evidence of the disease was found in any instance. The fact that it was not necessary to concentrate any of the employees in rabies districts aided materially in carrying out the work where instituted on a normal basis.

Communications received from individuals and live stock associations have conclusively proved the value of predatory animal work as conducted under the policy of the State Department of Agriculture and the U. S. Bureau of Biological Survey in cooperation with counties and wool growers' associations.

WEED CONTROL.*

Puncture Vine *(Tribulus terrestris).*

State-wide Interest.

The infestation of puncture vine in 1925 was so much heavier than in preceding years that it engaged attention in nearly every section of the state. This increased infestation was no doubt due in part to the late spring rains and other weather conditions during the year, but more to the natural spread of the weed under conditions found in this state. The automobile is undoubtedly the most important factor in spreading this pest, and it is only to be expected that the use of roads and highways by increasing numbers of vehicles will continue the rapid dissemination of puncture vine.

In the summer of 1925 several meetings were held independently by groups of individuals in various parts of the state to consider a plan for concerted action against this pest. In Kern County there had been a puncture vine committee functioning for two or three years as a project of the Farm Bureau in cooperation with the horticultural commissioner. In Merced County a committee was formed of representatives of all organizations interested in public service, and a project drafted for country-wide publicity and action under the leadership of the horticultural commissioners. In Fresno a "Puncture Vine Week" was set aside in an attempt to destroy the weed in that city. On August 19, the horticultural commissioners of the Sacramento Valley, meeting at Fairfield, discussed the situation in that section with respect to the use of more uniform methods of handling. On August 28, at a meeting of the League of southern California Horticultural Commissioners in Los Angeles, a report was made of the past and projected work on puncture vine in each of the northern counties and a plan for uniformity of action discussed. On August 19, a meeting was called by the Puncture Vine Committee of the San Joaquin Valley Regional Board of the California Development Association for the purpose of discussing a plan for uniform action in the San Joaquin Valley. The Department of Agriculture and the San Joaquin Valley horticultural commissioners were requested to draft such a plan to be submitted at a later meeting. The following was offered at a meeting held in Sacramento on September 9 and accepted as a basis for action in the San Joaquin Valley and later for the entire state:

OUTLINE OF PUNCTURE VINE CONTROL SITUATION IN CALIFORNIA.

I. GENERAL.

A. *History.* Puncture vine has been known to exist in California for a number of years. Probably introduced into California with shipments of live stock. It is presumed that it came into the United States either in ships' ballast or in the wool of sheep from the Mediterranean region.

B. *Distribution.* Puncture vine is found chiefly in those California counties which are traversed by any main line railways. The most heavily infested districts are in the San Joaquin Valley and in Southern California. In Northern California, in the coast and mountain counties the infestations are still quite limited.

C. *Spread.* The spread of puncture vine is chiefly along routes of travel. It is readily carried by automobile casings and by sheep and other live stock.

---

* By Ethelbert Johnson, Superintendent of Weed Control.

Plants are found along highways, county roads and city streets. Railway rights of way are likewise favorite locations, the seed being dropped out of cars hauling gravel, sand or bedding for live stock.

D. *Control.*

1. *Methods.*

a. *On untilled areas*, including railroad rights-of-way, roadways of all types, non-cultivated irrigation ditch banks, lands under the jurisdiction of political subdivisions, such as school grounds, vacant and undeveloped lands and easements, control for puncture vine seems best consummated by spraying with petroleum products, slop distillates or fuel oils, preferably followed by burning.

b. *On agricultural or productive lands* intensive cultivation is generally necessary.

2. Cost.

Cost varies with material and equipment used, and amount of labor involved.

E. *Control Campaign Difficulties.* In the past, endeavor has been made, in a number of instances, both by the State Department of Agriculture and the various county horticultural commissioners to conduct a campaign against this noxious weed pest, but in only a few of the counties has there been sufficient public interest to make such a campaign continuous. Furthermore, the usual control measures proved ineffective, and it became necessary to conduct investigations to determine an efficient and economical method of control.

F. *Renewed Activity.* The past season, 1925, has brought puncture vine forth in far greater quantities than has been known in the past. There has been greater public interest in its suppression than has been heretofore known, and numerous counties, through their horticultural commissioners, and other agencies, have been actively interested. Further, an effective control has been developed. In other words, a particularly auspicious season is at hand and it is believed that in the coming years there will be even greater interest, which will aid materially in any campaign conducted for the elimination of this weed.

II. IMPORTANT CONSIDERATIONS.

A. Any campaign against a serious weed pest necessarily contemplates a program covering several years.

B. All possible agencies which might have any interest or connection whatever should be lined up for any assistance they may be able to render.

C. Uniformity of campaign in groups of counties, insofar as practical, is important.

D. A campaign should be well balanced and conservative, yet consistent.

E. Fundamental matters pertaining directly to a campaign should be carefully considered, such as:

1. Life history and habit.
2. Methods of spread.
3. Methods and costs of control.
4. Educational facilities.

III. BASIC PLAN FOR STATE-WIDE OPERATION.

A. *Leadership.*

1. For each county, the county horticultural commissioner.
2. For the state as a whole, the State Department of Agriculture to advise with the county horticultural commissioners, to coordinate operations and aid in obtaining cooperation of agencies controlling infested areas from which spread is most common.

B. *Procedure.*

1. Method to be determined by the horticultural commissioner of each county on the basis of local conditions.
2. In order to further such methods the State Department of Agriculture will assist on the basis of past and future investigations.

3. The horticultural commissioner to coordinate in so far as possible the activities of all cooperating agencies within his county.
4. The State Department of Agriculture to coordinate the activities of cooperating agencies for the assistance of the commissioners where such agencies operate over an area greater than a single county.
5. Primary effort to be directed to chief sources of spread, e. g. railways, highways, county roads, city streets, irrigation ditches and areas not privately owned but under the jurisdiction of some political subdivision.
6. Utilization to be made of any practical educational features.

IV. COOPERATING AGENCIES.

1. California Development Association.
2. Farm advisers.
3. Farm bureaus.
4. Chambers of commerce.
5. Banks and Trust Companies.
6. Automobile clubs.
7. Civic clubs.
8. Schools.
9. Boy Scouts.
10. Local weed control committees.
11. Press.

V. AGENCIES INTERESTED BY VIRTUE OF THEIR CONTROL OF INFESTED PROPERTY.

1. Boards of supervisors.
2. City councils.
3. Irrigation districts, reclamation districts, etc.
4. School trustees, park trustees, etc.
5. State Highway Commission.
6. Railroads.
7. Other public utilities.

CONTROL METHODS.

The usual mechanical methods employed in the control of annual weeds, designed to destroy the plants and to prevent seeding, are unsatisfactory in the control of puncture vine except in agricultural land where intensive cultivation can be practiced. It is necessary for success in controlling puncture vine by scraping, hoeing, and similar methods, to cut off the plants below the crown before the seed is formed. New plants sprout continuously during the season of warm weather and make a very rapid growth, the burs beginning to form at an early stage. These young burs, picked even before the spines become rigid, have been found to contain seeds capable of germination. The hoeing, or analogous process, therefore, in order to be effective, must be repeated at frequent intervals. During the period of most rapid growth these intervals must be as short as five to seven days. It is possible to extend the intervals somewhat if the hoed plants are gathered and burned, but this method is not completely effective unless the plants are cut before any of the burs are fully mature and unless the plants are gathered before wilting, for the reason that the mature burs, and even the immature burs when the plants have been permitted to dry, will shatter off when the plant is disturbed.

As the end to be accomplished is the prevention of seeding, as well as the destruction of the plant, it is obvious that any method which does not do both can not be considered completely effective. From the foregoing consideration it will be apparent that effective control can be accomplished only by destroying both plant and seed *in place*. To this end, two methods suggest themselves: (1) Treatment with a chemical which not only will kill the plant, but will penetrate the burs and destroy the seed; and (2) burning.

Of the various chemicals which may be used to kill puncture vine, only the petroleum products have been given any extensive trial. It has been found that such cheap grades of oil as slop distillate, tops, smudge oil, Diesel engine oil and other low grade fuel oils will readily penetrate the mature burs and destroy the seeds as well as kill the growing plants. The green burs which are fully formed but not yet dry are more difficult to injure, as the natural moisture in the bur prevents the spreading of the oil and its penetration into the seed-bearing cavities. These green burs rarely show more than one viable seed, whereas mature burs show usually two, often three and occasionally even four viable seeds. Where the spraying is not done until the green burs have formed, therefore, a second treatment is necessary. A second spraying with oil may be used, or the plants may be burned in place.

Burning alone has not proved practicable. The green plants, and particularly the green burs, require such great heat for their destruction that the cost of effective work is very high. Burning in place after the plants have been killed by chemical or other means is advisable wherever practicable. It is difficult to burn even the dry plants in place, however, unless they are treated with oil immediately prior to burning. A lighter application is necessary on this second treatment where burning is to follow than where the plants are to be left, as the heat and not the oil is depended upon to destroy the seeds.

A group of materials which are promising and deserving of further trial are the acid sludges, by-products of the refining of various grades of petroleum products which are composed chiefly of concentrated sulphuric acid, together with the impurities removed in the refining process, which are of themselves virulent plant poisons. The acid sludges have the advantage of being capable of dilution in water, and in 15 to 20 per cent solution will destroy the seeds of puncture vine. These materials are therefore both cheap and effective. They require, however, special acid-resistant equipment for handling, as they are, when diluted, highly corrosive to steel and certain other metals. Specifications for acid resistant equipment can probably be worked out, however, at a cost which is not excessive.

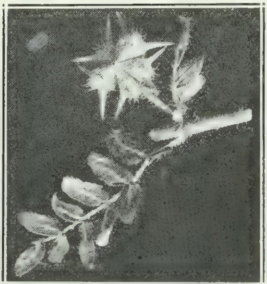


FIG. 11a. Detail of portion of puncture vine (*Tribulus terrestris*) plant showing leaf and maturing bur cluster. This cluster divides into five burs each with two heavy spines.

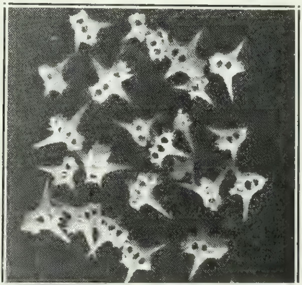


FIG. 11b. Puncture vine burs eaten by mice for the seed. Shows average of three seed carriers in each bur, giving fifteen to the cluster and thousands to each mature plant.

Low grade petroleum oils in emulsion with caustic soda may be used to kill the plants and will kill a portion but not all of the seeds. Both 50 per cent and 25 per cent solutions have proved effective on the plants, and it is probable that still more dilute solutions can be used. These emulsions may be used on the young plants before the burs are formed, and will be found cheaper and quicker than hoeing. They may also be used as a preliminary treatment after the burs are formed, to be followed by burning or by an oil spray.

Camels' Thorn *(Alhagi camelorum).*

Probable Introduction into California.

It was at first presumed that the sole source of the introduction of camels' thorn into California was in connection with the importation of date offshoots from North Africa. The evidence in support of this supposition was circumstantial only, but convincing. The camels' thorn is a common species of vegetation in Egypt, according to botanists, and is valued as browse for camels, who eat not only the tender young shoots, but also the old dried shoots with the seed pods attached. It is a common practice, it seems, to pack the offshoots in camel's dung, and it would be quite possible for the dung to contain the small hard seeds of this plant, which might readily pass through the intestinal tract unharmed. Unquestionably some of the patches in California were started in this way by horses having eaten the mature seeds. It is claimed, however, that none of the offshoots imported into California were packed in camel's dung. Furthermore, no camels' thorn has been found on any of the plantations of imported date offshoots, although at least two patches of the weed have been found growing among seedling date plantings. It is possible, however, that some of the imported offshoots may have been unpacked on the site of some of the infested patches, and that even if the offshoots were not packed in dung, the seeds might have been lodged at the base of the fronds, or that pieces of the camels' thorn roots may have been entangled with the roots of the palms. Both conditions have been observed where the camels' thorn has been found growing among date palms.

It has recently been established that camels' thorn may have been introduced into California in another manner which does not necessarily exclude the former theory as an additional possibility. The Federal Seed Laboratory at Washington, D. C., has made a collection of weed seeds indicating the origin of certain crops. Alfalfa seed from Turkestan was found to contain among other weed seeds, the seeds of Russian knapweed *(Centaurea repens)* and of two unidentified legumes. One of these legumes appeared nearly always in the pod, and was nearly always immature. This unidentified legume was determined to be camels' thorn by Miss Cole of the California Seed Laboratory, who was familiar with the seed from California specimens. Between 1900 and 1918 a considerable quantity of Turkestan alfalfa was imported into the United States, sometimes by the varietal name, at other times, by the name of German alfalfa, because of the fact that most of it was handled by German firms. From the time of the establishment of the California Seed Laboratory in 1912, samples from all importations of alfalfa seed arriving from foreign countries through Pacific ports were examined at the California Laboratory. The records for the period from 1912 to 1918, when importations of Turkestan alfalfa were stopped on account of reduced demand and post-war conditions, repeatedly show the presence of "Leguminosae" in Turkestan samples. Miss Anna M. Lute, who was at that time in charge of the California Seed Laboratory, wrote under date of October 27, 1925:

"At the time when Turkestan alfalfa was very much in vogue, there were two unidentified legumes. These were marked on our sheets merely as "Leguminosae" and reported as "undetermined legumes." One of these has since been identified as *Alhagi camelorum.* The other is still undetermined. If you have the Federal illustrations of seeds, you will find Plate 10, No. 5 is *Alhagi camelorum.* No. 4 Plate 10 is still an undetermined legume."

Turkestan alfalfa, as noted above, contains as the most characteristic impurity, the seed of Russian knapweed. In at least three places, all in Imperial Valley, camels' thorn and Russian knapweed are found growing on the same premises. In each of these places Turkestan alfalfa was at one time planted. This variety of alfalfa was widely planted in California, and is believed to have been responsible for the introduction of practically every patch of Russian knapweed. Russian knapweed has been found in about twenty counties, from Imperial to Glenn. Why, then, has not camels' thorn been more widely introduced?

Russian knapweed was found to occur invariably in every sample of Turkestan alfalfa. Camels' thorn was found in fewer samples and in smaller proportion in the individual sample. The seeds of camels' thorn found in the samples were nearly always immature. Camels' thorn even when mature is very difficult to germinate at ordinary temperatures, but mature seed germinates fairly well after scalding with hot water. Samples gathered from California specimens in different years show a high percentage of so-called hard seeds, that is, seeds which are apparently viable, but which because of a hard waxy coat which prevents moisture from reaching the seed proper, do not germinate at ordinary temperatures.

Laboratory tests show that a fairly good germination of camels' thorn can be induced by first scalding the seeds by dipping into boiling water. This treatment is similar to the conditions met in a desert habitat after a summer rain, and the conclusion would seem to be that camels' thorn requires such a condition in order to propagate itself by seed and that it would therefore not readily establish itself by seed except in sections similar to its native habitat.

Eradication.

In Imperial Valley the owners of most of the patches of camels' thorn are attempting by voluntary effort to eradicate this weed but in the Coachella Valley the owners have been unable or unwilling to undertake the work. The first attempts at eradication in the Coachella Valley were undertaken by the horticultural commissioner under the provisions of the Political Code, providing for abatement of certain classes of nuisances, the expense of abatement becoming a lien on the property. It was found impossible to follow strictly these provisions of the law without interrupting the work so as to interfere with that continuity which is necessary in order to eradicate a weed by clean cultivation. An unsuccessful attempt was then made to secure State funds to undertake the work. In July, 1925, the Riverside County board of supervisors authorized the expenditure of $10,000 to undertake the summary abatement of camels' thorn. The greater part of the allotted amount was expended in clearing the land of brush and trees, including an abandoned date planting. The camels' thorn roots were so intermingled with the roots of these trees that it would have been impossible to destroy them without removing the trees. It was not unusual to find the camels' thorn roots growing between the bark and the wood of old tree roots. Since the land was cleared it has been kept worked up to a depth of eighteen inches and no live tops permitted to form. It is planned to continue this work until all the living roots are starved out, when it will be necessary to keep the field under observation for a number of years in order that any seedlings which are produced from the millions of seeds in the soil may not become established.

Russian Knapweed *(Centaurea repens).*

Distribution.

Since the publication of the first article describing Russian knapweed in the Monthly Bulletin of this Department for March, 1923, a number of additional patches have been discovered. Several of these new stations were noted in the annual reports of 1923 and 1924. In order to bring together the data now available on the distribution of this weed, there follows a list of stations reported to date:

County	*Localities*
Imperial	Calexico, Bond's Corners, Brawley
Orange	Greenville, Delhi, Smeltzer, Garden Grove, Stanton, Buena Park
Riverside	Arlington
Los Angeles	Artesia, Bellflower, El Monte
Ventura	Oxnard, Ventura
Santa Barbara	Solvang
San Luis Obispo	Arroyo Grande, Los Osos
Monterey	Metz
Santa Cruz	Watsonville
San Benito	Paicines
San Mateo	Menlo Park
Glenn	Norman, Willows
Sutter	Rio Oso
Sacramento	Dos Pasos
Stanislaus	Crow's Landing
Merced	Tuttle
Fresno	Helm
Tulare	Tipton

Commercial Herbicides.

A number of superficial observations have been made on the use of certain proprietary weed-killers. Some of these materials are sold under the claim that they will destroy the underground parts of certain perennial weeds when sprayed on the tops. Test plots for the control of Russian knapweed, morning glory, white horse-nettle, hoary cress and a variety of annual weeds have been under observation. In some of these test plots, and under certain conditions, the plants were killed to a considerable depth below the surface, and it would appear that if the same results can be obtained in every case, such a treatment may be developed as a commercial control if not as a possible eradication method.

Since the need is great for a material which will cheaply and effectively destroy the underground parts of perennial weeds without injury to the soil, and since because of the demand for such a material unscrupulous manufacturers of herbicides are often induced to make extravagant claims for their preparations, it is of importance that investigation be made of such of these materials as show promise, in order to determine their value and proper use.

Carbon Bisulphide.

It has long been recognized that carbon bisulphide is one of the best chemicals for the destruction of perennial weeds. While it is not more poisonous to plants than many other materials, its property of rapidly penetrating the soil, its killing effect on all kinds of plants, and the fact that it is not permanently injurious to the soil makes it of peculiar value under suitable conditions. The principal disadvantage has been the cost of application. The method usually employed is to apply by hand in holes drilled in the soil about eighteen inches apart and twelve to eighteen inches deep, at the rate of two ounces per hole. The labor cost added to the cost of the material has made the expense of the carbon bisulphide treatment prohibitive except in situations where the cost is of minor consideration, as where a small patch of perennial weeds must be eradicated to prevent spread to a large area. It has been found that carbon bisulphide can be applied cheaply and conveniently by a simple attachment on a subsoiler which allows the liquid to drain through a pipe at the bottom of the furrow. The furrows may be made about three feet apart. Quantities as small as one ounce in three linear feet may be used in soils of good permeability. Caution should be given against attempting to reduce the quantity to too small an amount per cubic yard. The susceptibility of plants to low concentration of the gas is not great. For this reason, an emulsion or solution of the material is not advisable, as the tendency to release the gas more slowly so as to form only a low concentration, even though prolonged over a period of time would reduce the efficacy of the gas. A high concentration applied suddenly is essential to successful treatment.

NURSERY SERVICE.*

The Directory of Nurserymen and Seedsmen, 1924-25, was published in February, 1925, as Special Publication No. 53 and gives a complete list of those registered and licensed to date, with their addresses and classification. The laws and regulations affecting California nurserymen were also noted. For the fiscal year 1925 there was a total of 1271 licensed firms and individuals engaged in the nursery business. Indications for the fiscal year 1926 would point to a considerably larger number. Probably about 1500. The listing of such parties provides a means of closer contact with the trade, and makes possible more uniform action in pest control under the suggestion of the State Department of Agriculture and the county horticultural commissioners.

Continued contact has been maintained with the nurserymen and horticultural commissioners on problems relating to the nursery service, which has resulted in a better understanding and correction of the horticultural laws and their interpretation.

Pest conditions this past shipping season as a whole have been very satisfactory. This was particularly so with the ornamental and citrus shipments. Only in a comparatively few instances have complaints been received from the larger plant mail-order concerns, while carloads of ornamental stock moved into localities from nurseries heretofore unable to ship.

---

* Joint Report by R. D. Hartman and Everett L. Smith, Nursery Service Superintendents, Sacramento.

The crown-gall situation among deciduous fruit nurserymen has been corrected to a considerable extent by the recent provision in the horticultural statutes which gives the commissioner at point of origin the authority to hold the affected trees.

The two major pests affecting ornamental nursery stock are the Citrophilus mealybug, *Pseudococcus gahani* Green, and the Argentine ant, *Iridomyrmex humilis* Mayr. Extensive experiments have been carried on to determine the most practical and effective method of control. These results favored the use of sprays under field conditions followed by dipping the stock prior to shipment, using 12½ per cent of Special Refined Oil in both applications.

Numerous colonies of Argentine ants on several nursery projects over the state have been satisfactorily cleaned up by using the system which consists of the regular U. S. Government or "Barber" syrup formula having $\frac{1}{10}$ of 1 per cent sodium arsenite as its active ingredient and using a two-ounce heavy glass container with an aluminum top to hold the liquid. Autumn, winter and spring months proved the most satisfactory to carry on an Argentine ant campaign.

Pest surveys have been made on the European elm beetle, pecan leaf case bearer, Dictyospermum scale, pepper weevil, black vine weevil, soil mealybug, European earwig and raspberry crownborer. The fullest cooperation has been received from the various members in the department as well as nurserymen and horticultural commissioners in carrying on the activities of the Nursery Service. Great assistance has been rendered by the collaborator in the southern part of the state who carried out his instructions to the letter.

VITICULTURAL SERVICE.*

A vineyard survey of the state was made in the spring of 1925 to ascertain to what extent the dry year of 1924 had affected the vigor and growth of the vines and to determine the probable size of the grape crop for 1925. The survey was undertaken at the urgent request of the grape industry represented by growers and fruit distributing concerns. The transportation companies were eager for information at an early date in order to gain an idea of the number of cars necessary for grape shipment to eastern markets.

To be of practical value, such a survey required close investigation of vineyard conditions in all counties where grapes were grown on a commercial scale. A cooperative program was adopted with the county horticultural commissioners wherever these officers were able to assign inspectors to obtain the necessary information, which information was verified by this office from time to time. Where assistance through these county officers was not available, special men were assigned under the direction of the California Department of Agriculture. There were seven such special investigators.

Vineyard Conditions.

The appearance of the vines, except in phylloxerated vineyards, belied actual conditions, inasmuch as vigorous and healthy growth was apparent, but investigation developed the fact that this vigorous growth was made at the expense of fruitfulness, and was somewhat accelerated due to favorable weather conditions. Early in the season proof was evident that the vines were in a weakened condition due to the dry spell of the previous year. New shoots were put forth at three different times at intervals of from a week to two weeks. The first shoots sprouted were very vigorous and thicker than normal, growing in length with exceptional rapidity and with unusually long internodes. These shoots were fruitful but not to a normal extent, bearing only one blossom cluster as a rule, when there should have been two and for some varieties three. The second series of shoots was conspicuously below average strength and vigor and bore generally inferior blossom clusters. Often, on one vine, three stages of shoot growth were distinctly noticeable, particularly with reference to the fruit clusters and the setting of the fruit, some berries being about the size of peas on the first sprouted shoots, while only blossom clusters were present on the late sprouted shoots. The singular condition of growth was not peculiar for any district or variety of grapes, but appeared to be quite general throughout the state.

---

* By R. L. Nougaret, Viticulturist, Sacramento.

This condition was less conspicuous in the Lodi district where the sprouting of the vines was more or less normal due to availability of water for irrigation during the 1924 season. The clusters of fruit in this district showed many shotberries and nonsetting of fruit in the case of vines having shorter and less thrifty canes brought about by a weakened condition.

The irregular and apparently abnormal behavior of the vines may be explained on two bases. In the first place the vines had suffered to a certain degree from the prolonged drought of the previous year and possibly also because of having produced too heavily for the dry conditions, and any reserve food material available was utilized in fruit production, instead of storing reserve food in the plants for the following year. The fact that only a part of the buds opened at first is quite conclusive indication of a lack of vitality. In the second place the early rainfall of 1925 was fairly normal. The soil received sufficient water for the vines to generate a comparatively heavy sapflow causing a faster length growth and a larger size growth. In response to an excessive sapflow, the stronger vegetative buds sent out shoots in advance of the weaker buds, giving an appearance of a second growth when the latter began to elaborate. Inasmuch as these shoots were forced in the main from dormant fruit buds, they also were generally fruitful. When later a third period of sprouting occurred most of the energy had been used up in putting out the early groups of shoots, hence the third lot did not bear blossom clusters to the extent that the first and second growths had, many being nonproductive, similar to watersprouts.

Coulure likewise had some considerable effect upon the size of the year's grape crop. This condition is the result of defective pollination, and is also fostered by a very luxuriant herbaceous growth. When berries are formed they remain more or less atrophied through lack of or faulty pollination, and may remain quite small (shotberry), or they may merely be undersized due to abnormal organic structure, (waterberry), caused by defective pollination and continued inability to gain headway in growth in competition with excessive numbers of berries in the bunch. Low temperatures and high humidity have a tendency to cause this condition at time of pollination. In either case, however, whether shotberries or the larger waterberries, the result is a defective quality, the smaller size or shotberry being the more noticeable and detracting appreciably from the appearance of the fruit. If conditions are entirely favorable, these berries may develop characteristic color, acquire a fair sugar content and be palatable, even though organically unsound, but they have a tendency to cause very poor keeping qualities in shipments. During 1925 the Malaga and Thompson Seedless varieties principally had their quality impaired due to waterberry, and as a matter of fact practically all varieties except Muscats were affected with inferior berries.

Special notes were taken on certain specimens of grapes with a view to determining the cause of prevalent poor quality. In a vineyard in Kings County several bunches of Malaga and Muscat grapes were tagged and left on the vines. These bunches were selected as being representative samples of types reported from eastern markets as lacking good shipping qualities with particular reference to color, firmness and size. The samples had berries which were off-color and which were softer and more watery than normal.

Certain bunches were left on the vine, others picked and notes taken from time to time during the period from September 3 to October 11, or until they became ripe. On September 3 three pairs of bunches were selected from the same vine and in the same general position. Of these, one bunch of each pair was picked and the remaining three tagged and left on the vine, with a view to determining the varying results between those picked and those left hanging until full ripeness on October 11. The results are shown in the following table:

Malaga Grapes.

		Bunch picked September 3	Bunch picked October 11	Possible difference
Pair No. 4.	Sugar	19.1%	20.8%	Gain 1.7%
	Acidity	0.645%	0.5775%	Loss 0.0775%
Pair No. 5.	Sugar	16.7%	19.6%	Gain 1.9%
	Acidity	0.5625%	0.4125%	Loss 0.15%

The quality of these bunches of grapes remained inferior to normal ripeness and they continued to have some waterberries.

Summarizing the results of the investigation with reference to the effect of drought it would appear that the conditions arising during 1925 were basic in the early development of the vines and the resulting effects upon the crop were as follows:

Excessive growth was induced from early moisture conditions at the expense of fruitfulness; a heavier production of crop than the vine could normally sustain during the previous year had used up any reserve food storage and had weakened the vines to the extent that coulure, or defective pollination, produced an appreciable quantity of inferior berries; and continued hanging on the vines up to full maturity did not correct the situation which was apparently the normal outcome of the droughty conditions.

Grape Phylloxera Situation.

Vineyards suffering from phylloxera showed signs of serious decline in vigor with prospects during 1925 of these vines being more stunted in growth than they were prior to the dry year. The damage caused by this insect unquestionably becomes greatly aggravated by a lack of moisture during a long period. Accumulative destructive effect causes the vines to have much greater difficulty in recuperating to the point of vegetative vigor previously possessed. Normally, acreages seriously affected by phylloxera and stunted in their growth would be dug up, but growers did not seem to realize the possible aggravated effect, laying same mainly to the dry condition which prevailed during 1924, and hoping by continued irrigations in 1925 to revive their vines. These vines will be removed ultimately, at least the seriously affected ones. During the dry year phylloxera infested vines in some sections showed the effects of the insect infestation so severely that it hardly paid to pick the grapes produced, although prior to 1924 there was some profitable production.

In the interior valley counties, particularly Tulare and Fresno, the condition was more apparent and about 2500 acres in Tulare and several hundred in Fresno were removed. The survey indicated that more vines were being planted on phylloxera resistant roots than ever heretofore, and all such vineyards can be brought back to their normal vigor in spite of the drought period. It is probable that more acreage of vines was dug up in 1925 than 1924, due to the after effects of the dry year together with the phylloxera injury noted.

Brown Rot of Grapes.

The survey revealed the presence of a fungus disease on the grapes which rarely occurs under normal weather conditions. Specimens of blossom clusters and clusters with set fruit were submitted to the plant pathologist of this bureau for determination and we quote his report herewith:

> A disease of grapes occurred in 1925, which either had not occurred in previous years or had occurred in such small amounts as to escape attention. For want of a better name, it can be called brown rot, a term which is very descriptive.
>
> The disease affects directly the current growth of cane, petiole, rhachis and peduncle, all young, succulent woody parts of the vine. From the peduncle the casual fungus travels to the blossoms and young berries.
>
> The disease is characterized by the development of brown, watersoaked lesions. These lesions may be small spots in the beginning. Later they develop into large, irregular areas in which the tissues underlying become soft, watery and brown. On the surface of such areas, the casual fungus produces a luxuriant growth of mycelium, conidiophores and conidia often covering the entire affected area and giving it a grayish appearance.
>
> The causal fungus has been identified as a member of the *Botrytis cinerea* group. Its development was favored by late spring rains accompanied by optimum atmospheric temperatures.
>
> While the amount of damage done to the grape industry was very small, probably less than 0.5 of one per cent of the whole crop in the state, it was very evident from observations in 1925 that under favorable conditions the disease can cause an appreciable loss over a large portion of the state. In any consideration of this disease, it is important to recognize the possibility of an accumulation of the wintering stages of this fungus in any vineyard, which, if the accumulation is permitted to continue, may cause the loss of the entire crop of the year.

BUREAU OF FRUIT AND VEGETABLE STANDARDIZATION.

W. F. ALLEWELT, Chief.

The Bureau of Fruit and Vegetable Standardization, during the year 1925, has carried on four principal activities.

(1) Fruit and Vegetable Standardization Service.
(2) Apple Standardization and Inspection Service.
(3) Shipping Point Inspection Service.
(4) Potato Seed Certification Service.

The administration of the California Canned Fruit Standardization Act, passed by the legislature, has been assigned to the bureau of Fruit and Vegetable Standardization. It is a new law requiring the marking of cans of "second" grade fruit, and providing certain minimum specifications for fruits and syrups packed under "standard" grade. The act goes into effect the first of the year 1926, and inspection will be provided by this bureau in accordance with the provisions of the law.

Fruit and Vegetable Standardization Service.

Since the California Fruit and Vegetable Standardization Act was revised by the legislature in 1925, the activity of the bureau has covered the administration of the Fruit and Vegetable Standardization Acts of 1923 and of 1925. While the bureau is directly charged with the enforcement of *this* law, the work is carried on principally by the county horticultural commissioners of the state, with their deputies and inspectors, who are named by the act as enforcing officers. The principal function under the authority conferred on the Director of Agriculture is to secure thorough, efficient and uniform enforcement in all districts and counties throughout the state.

The Standardization Act establishes certain minimum requirements with which the nineteen fresh fruits, nuts and vegetables specifically mentioned must conform, and designates standard packages, packs and markings. In addition to the specific requirements for these crops which are mentioned, the general provisions of the law prevent deceptive packing or false or misleading markings on any containers of fresh or dried fruits, nuts and vegetables.

One of the outstanding accomplishments during the year 1925 was the inspection of oranges throughout the central and southern districts of the state. The loss by frost during the latter days of the previous year was estimated at from 25 to 35 per cent of the entire crop. The problem of keeping the frosted oranges from both local and Eastern markets was of fundamental importance to the industry, and entailed a great amount of inspection in nearly all of the citrus packing houses of the state. Due very largely to the splendid cooperation between the county horticultural commissioners, the State Department of Agriculture and the orange growers and shippers, the amount of seriously frozen oranges which were shipped or sold on local markets was negligible. This concerted action and thorough inspection kept the markets in good condition, and resulted in a saving of many millions of dollars to the industry. A representative in the citrus growing sections throughout practically the entire year aided very materially in unifying the work in the different counties.

During 1925 a special effort has been made both by the county horticultural commissioners and the department to more thoroughly inspect the fresh fruits, nuts and vegetables handled in our local markets. The fact should not be overlooked that our California markets offer one of the most remunerative channels for the disposal of these important crops. In the past, many growers and shippers have sold in local markets produce which they did not feel was of sufficiently high quality to be shipped to distant parts of the country. The Bureau of Fruit and Vegetable Standardization has encouraged the systematic inspection of all truckloads of produce going into California markets from the producing areas, and in many districts of the state the work has been carried out very successfully by the county horticultural commissioners and their forces, with the result that the market demand for such products when properly standardized has been materially improved.

The revised California Fruit and Vegetable Standardization Act, passed in 1925, made a number of changes which strengthened the work considerably, particularly in regard to requirements affecting lettuce and walnuts.

During the year 1925, according to figures issued by the U. S. Department of Agriculture, nearly 250,000 carloads of fruits, nuts and vegetables were shipped from California points. With this enormous increase in production, the problem of standardization of these crops is becoming of greater importance each year, and the shipping of high quality, well graded fruits, nuts and vegetables, in standard containers, is recognized by the industry as essential in the satisfactory and profitable handling of these products. There has been a general feeling throughout the entire industry that the minimum standards now established in the law should be further strengthened, and steps are being considered to accomplish this in the manner desired by the industry.

Apple Standardization and Inspection Service.

The California Standard Apple Act was amended by the 1925 legislature, being strengthened in several particulars. One of the most important of these was the delegation of specific authority and responsibility for enforcement to the county horticultural commissioners of the state and their deputies and inspectors, in addition to the State Department of Agriculture, formerly named as the enforcing organization.

The three standard grades established in the act, Extra Fancy, Fancy and C grade, which have been made to conform as closely as possible with those of the other western boxed apple states, were not affected by the amendments. Under this law all apples packed, shipped or sold in California, irrespective of where they were produced, must be marked with one of these standard grades and comply with its specifications, or else be marked "unclassified apples." Unclassified apples are required to be free from insect and fungous pests.

The enforcement of the act, conducted by the State Department of Agriculture, is financed entirely by the payment of a fee by the packer for the use of the official state inspection stamp, which is placed on each package, showing the grade of the apples and the fact that they have been officially inspected and passed by the State Department of Agriculture as meeting all requirements of the California Standard Apple Act and the grade designated. In addition to the force of the Department, the county horticultural commissioners, as stated above, have been definitely named as enforcing officers and authorized to prevent any violations of the act. This has resulted in a greatly increased efficiency in the work through the addition of such a large force of men, who have displayed an active interest in the administration of the law.

The California apple crop for 1925 has been estimated at about one-half of normal, the quality of the fruit and the price received being equally disappointing. The California Cooperative Crop Reporting Service has estimated that only 55 per cent of the production was consumed in a fresh state. Heavy codling moth infestation made packing very difficult in many localities and required close inspection on the part of the enforcing authorities. Notwithstanding these unfavorable conditions, 1536 cars of apples were inspected and stamped by the Department of Agriculture during 1925 out of a total of 2253 shipped.

In addition to the rigid inspection of apples shipped by rail, and those offered for sale on the markets of the state, particular attention was given to the inspection of shipments by truck. With the continued improvement of highway systems there has been a great increase in truck movement of apples, particularly to the Los Angeles and San Francisco Bay markets. These shipments, which occur principally at the first of the season, are apt to be poorly graded and below the requirements. Inspectors stationed on the highways this season have been able to inspect practically all of the truck shipments, thereby reducing the sale of substandard apples to a minimum and keeping the markets in a healthy condition.

Shipping Point Inspection Service.

Certification of fruits and vegetables, which was organized by the California Department of Agriculture in cooperation with the Bureau of Markets, U. S. Department of Agriculture, in July, 1920, was continued by the Federal–State Shipping Point Inspection Service during the past year. Upon the request of the grower, shipper, receiver or any other party having a financial interest in any lot of fruits or vegetables, an inspection is made and certificate issued describing in detail the quality, condition, grade, pack, load and other factors of importance. This certificate is receivable as prima facie evidence in any court of the Unted States, and is generally accepted as a basis of buying and selling cars which neither the purchaser nor the seller has seen. It also is used as a basis of settlement of claims for allowances and rejections, and in connection with insurance and the adjustment of claims against the railroads for damage. The service is entirely optional, fees being charged to cover the expense involved. These fees, under ordinary circumstances, are at the rate of $5 a car for carload lots containing not more than four different varieties or commodities.

This service has shown a material increase in the number of inspections made on nearly all commodities during the year, due very largely to a desire on the part of the shippers and buyers to have an accurate and unbiased report on the products they handle.

While most inspections were made on the basis of the United States grades for the various commodities, nevertheless it was quite noticeable in the case of some crops which generally failed to meet the specifications of these grades that there was little if any decrease in the number of inspections. It was necessary to increase the force during the height of the shipping season to a total of more than 170 inspectors. The greater part of the work, as in previous years, consisted of the inspection of grapes, which reached a total of more than 36,000 cars or 51 per cent of all shipments of *this* commodity. The accompanying tables indicate the growth of the service since its organization.

Carlot Inspections of Fruits and Vegetables, July 1, 1920, to December 31, 1925, by Years and Months.

	1920	*1921*	*1922*	*1923*	*1924*	*1925*
January		299	347	798	1,218	983
February		359	299	602	1,237	1,269
March		243	1,126	990	839	1,522
April		111	649	247	924	1,386
May		654	1,488	941	1,843	2,287
June		447	1,085	2,064	2,423	2,680
July	105	741	993	3,141	2,020	2,160
August	400	879	1,377	4,185	2,986	3,055
September	1,125	2,482	3,453	11,634	10,812	19,275
October	1,070	2,566	3,578	10,895	7,208	16,603
November	868	997	1,849	6,417	3,214	2,264
December	396	351	1,053	1,650	1,165	883
Totals	3,964	10,129	17,297	43,564	35,889	54,367

Comparison of Carlot Shipments and Inspections for the Years 1920 to 1925, Inclusive.

	1920	*1921*	*1922*	*1923*	*1924*	*1925*
Shipments	155,303	180,946	178,488	222,732	218,869	240,987
Inspections	3,964	10,129	17,297	43,564	35,889	54,367
Per cent inspected	2.6	5.6	9.7	19.6	16.4	22.6

Potato Seed Certification Service.

The United States Department of Agriculture has estimated that if the potato crop of the entire country were produced from high quality seed an increased yield of between 10 and 25 per cent would be the result. In a normal season the value of this quantity of potatoes would be between $40,000,000 and $100,000,000 based on the average prices paid for the crop, which means that from 10 to 25 per cent more land area than is necessary is being used for production of the potato crop in the United States. In other words, if only high grade seed were planted the average potato grower could produce the same yield of potatoes on from 10 to 25 per cent less acreage than he is now employing. Not only would this result in saving the cost of raising the potatoes on extra land, but it would leave the acreage available for other crops.

Applied to California, this would mean the release of from five to ten thousand acres for other crop purposes. The ultimate aim of potato seed certification is to produce a sufficient quantity of such stock to supply all of the potato growers of California who will use it. The maintenance of a potato seed certification service furnishes a supply of high producing stock for planting and insures the grower against introducing dangerous pests and diseases into his soil, in addition to assisting him in the selection of varieties adapted to his growing conditions.

A high standard of California certified seed potatoes has been maintained during the past year and a foundation laid for a greater expansion of this work in the future. More interest is being displayed by progressive growers in the seed producing sections in the raising of certified seed, and in the commercial potato sections low crop yields from poor seed have aroused an active consideration of the value of planting only good seed.

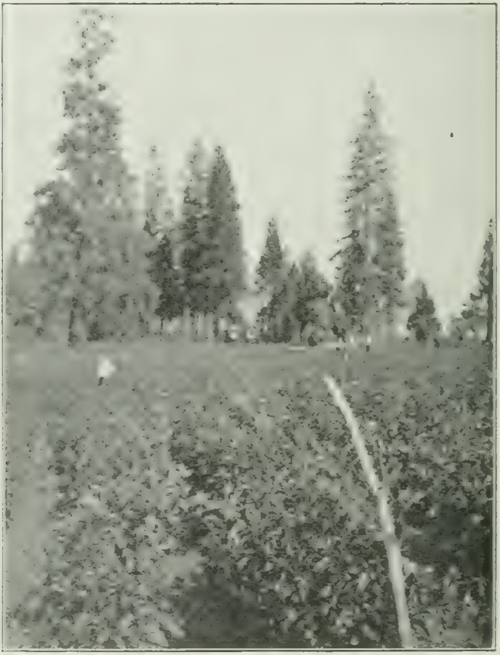


FIG. 12. Field of "certified" Burbank potatoes.

Recent information concerning the effect of virus diseases on the potato shows conclusively that no other group or kind of disease is exacting so heavy a toll on the yield. Owing to the insidious nature of these virus diseases, including the rapid spread, the difficulty of control, and complicated symptoms which are difficult to diagnose, it is only through seed certification that stock can be developed which is free from them or which contains only a negligible percentage. This is the task which potato seed certification should accomplish, and its value to the potato industry of California will be measured by its success.

BUREAU OF GRAIN, SEED AND WAREHOUSE STANDARDIZATION.

L. M. JEFFERS, Chief.

The activities of this bureau are divided into the following projects:

1. Grain inspection.
2. Seed laboratory.
3. Bonded warehouses.
4. Cotton classing.
5. Cotton seed certification.

With the exception of that portion of the California Seed Act which provides for the compulsory labeling of seed exposed and offered for sale under certain conditions, the work of the bureau may be classed as service, rather than regulatory work. Under such a basis of operation the activities depend upon crop conditions, market situations and the recognition on the part of producers and dealers of the benefits to be derived by taking advantage of the opportunities which are furnished by the establishment of such enabling laws.

There are appended several tables giving definite information as to the character and amount of work being performed in grain inspection, seed laboratory work, bonded warehouses and cotton classing.

Grain Inspection.

The California Grain Standardization Act of 1921 authorizes the Director of Agriculture to establish standards for the grading of agricultural products and provide inspection service applicable to these products. The grading standards established by the United States Department of Agriculture under the provisions of the Grain Standards Act become California standards in accordance with the provisions of our law. In addition to these federal standards for corn, wheat, oats, rye and grain sorghums, the California Department of Agriculture has established grading standards for barley, beans and rice.

A change in conditions of marketing and movement of grain necessitated the transfer of our Stockton Inspection Office to Vallejo. Inspection offices are also maintained at San Francisco and Sacramento. During the year the efforts of the department have been directed toward rendering a service to those desirous of securing grading certificates on grain bought or sold and to bring about a better understanding of the proper application of grading standards and the beneficial use of grading certificates. The most notable developments have been in the increased use of official state certificates in the grading of paddy rice.

The prevailing custom of marketing grain on the basis of sample submitted by the grower to the dealer has developed through years of practice covering a period of time when the official grading of grain on properly established standards was not available. Strange as it may appear to those familiar with customs existing in other sections of the United States, the producers are slow to change from the old bartering basis to the newer method of selling products under a system whereby both the seller and the buyer are equally well informed as to the quality and condition of the grain. The product as marketed is not only sold on an official certificate, but also at a price which is established in accordance with the prevailing price for the grade as sold and under conditions whereby the producer is properly informed as to the prevailing market conditions.

The development of a more economical marketing of our grain products will be greatly influenced by a more general use of inspection whereby the producer will not only secure proper returns for his high quality product, but through which it will be possible to develop market news information which will be definite and reliable. The best interests of California grain growers demand an early recognition on the part of the growers as well as the dealers of the necessity of recognizing the advantages of this system.

SEED INSPECTION.*

The Seed Inspection Service was established under authority granted by the Pure Seed Act of 1921. This service was incorporated as an integral part of the Bureau of Grain, Seed and Warehouse Standardization in 1923. The act, granting authority for the establishment of this service, is essentially the same as the Uniform Seed Law. It is a labeling act requiring that all lots of field seeds bear labels or statements giving the quality of the seed in the container. By these statements the purchaser can determine the quality of the seed which he is purchasing and intelligently control his planting rate.

The purpose of the Seed Act is not to prohibit the sale of any class of seed, but to enable the discriminating purchaser to obtain seed of high quality and germination. This is to the end that the quality of California's field crops may be increased and that the fields of California may be kept free from new weed pests and further dissemination of those weed pests which we now have.

The Seed Act requires two major functions of the Seed Inspection Service. First, to test samples of seed which may be submitted by farmers or seedsmen; second, to enforce the label provisions of the act itself. In order to carry out these two functions the law requires that the California Department of Agriculture establish and maintain a seed laboratory. This was established in cooperation with the U. S. Department of Agriculture in January, 1922, at 1217 L street, Sacramento. To this laboratory farmers and seedsmen are permitted to send samples of seed for test and analysis, and those samples which are taken of lots of seed offered on the market by inspectors of the department are analyzed here also.

During the calendar year 1925 the laboratory received for test 3503 samples of seed. The number included those samples submitted by farmers and seedsmen as well as those samples taken by inspectors of the department. The samples received for testing are classified in the laboratory under three headings: Public service, fee, inspection and investigation. The public service samples constitute those which are submitted by farmers and seedsmen and on which there is placed no charge for the work conducted. The number of samples tested free of charge for any one person or corporation is limited by the rules and regulations which have been adopted. The total number of samples which fell into this class during 1925 was 1868. Fees were charged on 1336 samples, the total amount of which was $1439.47.

---

* Report prepared by W. S. Wilkinson, Seed Specialist.

Considerable investigational work was conducted and a special investigation was made on the germination of onion seed. The investigation was caused by the failure of the onion seed crop of 1925 and the presence during germination tests of a certain percentage of abnormal sprouts. A report on the basis of the investigation was made before the annual meeting of the Association of Official Seed Analysts of North America at Kansas City in December. This report caused considerable attention to be drawn to onion seed germination. Another phase of investigational work was conducted on the germination of *Tribulus terrestris*—puncture vine. The burs of this plant were submitted by many of the commissioners in various sections of California, some of which had been treated and others left in their normal state. These tests are still being conducted.

The total number of samples analyzed is slightly less than the number tested during 1924. This slight loss was not unexpected since the year 1925 was an extremely poor one climatically for the planting and production of seeds. A number of the vegetable seed crops were an entire loss, and the returns from other seed crops were much shorter than those of previous years. The reduction in number of samples handled was occasioned to some extent by the fact that a commercial laboratory was established in Los Angeles with the cooperation of certain of the southern seedsmen. The submission of samples to this laboratory withdrew several hundred samples from the laboratory at Sacramento. Even with the bad year, more testing of seed was conducted in California during 1925 than in any previous year.

A large majority of the samples which were tested and analyzed were received during the last four months of the year. This caused a great congestion in the laboratory and taxed the efforts of the entire personnel. A peculiar feature of the samples received during 1925 was that a much greater percentage was received from individual farmers than in any previous period. Among the samples submitted for test was a series from the Association of Official Seed Analysts of North America. On the basis of the results of the tests conducted and reports submitted, the California Cooperative Seed Laboratory again received full certification as a recognized seed laboratory by the association. This certification means that the California laboratory is properly equipped and manned, and is conducting tests on a high standard.

More attention has been paid during 1925 to the required regulatory work than in previous years. Mr. Ethelbert Johnson was appointed as a collaborator of the service to handle the general inspection work in the counties of Southern California. In addition, twelve horticultural commissioners were appointed as collaborators of the Seed Inspection Service to enforce the label provisions of the seed act in the various counties. In addition to the inspection work conducted in the various counties by the collaborators, general inspection work was conducted in all of the coast counties south of San Francisco and in the counties of the Sacramento and San Joaquin Valleys. As a result of these inspections, a much closer check has been kept upon the labeling done by the various sellers of seeds. Companies which heretofore have not attempted to comply, have offered their full cooperation and are now complying as closely as possible with the requirements of the seed act. A considerable number of inspections was made during 1925 and during the course of these 69 inspection samples were taken. The analyses of these inspection samples shows that while most of those labeling seed are attempting to comply with the act, there is a measure of carelessness among some in having their label statements truly represent the lots of seed to which their labels are attached.

The requirements of the California Seed Act cover the cereal grains. In this connection, meetings were held with the grain trade in Los Angeles and San Francisco and an understanding reached as to the requirements of the seed act covering the cereal grains. As a consequence, a large percentage of the cereal grains planted in California and sold by dealers was labeled. During the course of the regulatory inspection work, the inspectors were again confronted with the violations of Allen W. Miller in the sale of Meadow fescue and other lawn grass seeds. Mr. Miller evaded arrest. The matter was then taken up with the U. S. Post Office Department and as a result of the complaint by the department, together with those of other states, the use of the mail was denied to the Zenith Lawn Accessory Co., of Kansas City, Mo., of which Mr. Miller is purported to be the proprietor.

As previously stated, seed conditions in California during 1925 were not the best. Cool moist conditions during the ripening period of certain of the vegetable crops permitted the inroads of diseases, which caused almost a complete loss of the crop. This was especially true of onion and parsnip. Tests now being conducted indicate that the germination qualities of the cotton seed produced in 1925 has been materially impaired. Indications are that the same conditions will exist with seed rice. Notwithstanding the unfavorable conditions existing during 1925 for seed production, California maintained its position in seed production as compared with other sections in the United States. Greater care was exercised by the planters, growers and seedsmen in producing and selling quality seeds. This was manifested by a greater interest among the seed trade in demanding seeds of quality and in testing the stocks which are being offered for sale.

Bonded Warehouses.

During the year there has been indicated a much greater interest in the provisions of the California Warehouse Act and the benefits which may be derived through the storage of agricultural products in warehouses which are bonded, licensed and regularly inspected by employees of the Department of Agriculture. While there has been a slight decrease in the number of bonded warehouses, there has been much greater interest expressed on the part of bankers, warehousemen and depositors in the provisions of the law. There also exists a much better understanding on the part of warehousemen, particularly, of the advantages which they themselves derive from the operation of bonded warehouses. It has been the endeavor of the bureau to render a valuable service to those who are interested in the handling, financing and marketing of our agricultural products rather than looking toward the mere increasing of the number of bonded warehouses in existance.

In September a cooperative agreement became effective whereby the California Department of Agriculture joined with the United States Department of Agriculture so that the administration activities and actual field inspection work are carried on jointly and irrespective of whether or not the warehouse is bonded under the United States Warehouse Act or the California Warehouse Act. This is desirable, not only from an economical standpoint, but also from the greater service which it is possible to render to the agricultural interests of the state.

The passage of the California Warehouse Act and the administration of the same have made it possible for the producers of the state to secure valuable financial assistance from the Federal Intermediate Credit Bank.

Cotton Classing.

The cotton classing office at Blythe was discontinued at the end of February, 1925, due to a comparatively small production in that territory and also lack of interest on the part of the producers. The offices at Bakersfield and Fresno were continued throughout the year with concrete evidence of greater interest and recognition on the part of the producers and a much better understanding and appreciation on the part of the buyers of the service which the Department of Agriculture is endeavoring to render to the cotton industry.

The tremendous increase in cotton production in the San Joaquin Valley has to a certain extent been instrumental in bringing about the better balancing of agricultural production and has also furnished to the growers a ready-money crop which has been of tremendous importance in stabilizing financial conditions in the San Joaquin Valley.

California cotton producers must depend upon quality and consequent premiums if they expect to be successful in cotton production. The production of quality cotton alone is not sufficient as it is necessary that the cotton be marketed under conditions which will fully inform the grower and the buyer as to the definite class and staple of the product and so result in giving to the grower the premium to which he is entitled.

The department has cooperated with producers and dealers in emphasizing the necessity of official recognition by the United States Department of Agriculture of the peculiar characteristics of California grown cotton and these efforts have been rewarded by the official establishment of cotton standards applicable to extra white cotton.

In connection with the cotton classing activities the department has received cooperation from the United States Department of Agriculture whereby it was possible to issue a weekly bulletin giving marketing quotations and premiums for extra grade and staple. It is hoped that through the establishment and use of the extra white cotton standards it will be possible to develop this Market News Service in such a way as to give to the industry more definite information which will be properly applicable to California cotton.

Cotton Seed Certification.

The 1925 legislature passed an act authorizing the Director of Agriculture to render a certification service to those desirous of having cotton seed certified. One important factor of this law is the provision that no cotton seed can be advertised or sold as certified unless it has in fact received the official certification of the Department of Agriculture. Rules and regulations controlling the certification of cotton seed were drawn up and issued. It is a well-recognized fact that the production of good cotton depends upon the maintenance of a one variety community and the use of quality seed. The department is not so much interested in the extensive application of the provisions of the Cotton Seed Certification Act as it is in the state-wide use of proper seed. It is gratifying to note the recognition on the part of the growers of the need of using good seed and it is to be expected that the mere fact that such a service is available and may be made use of will tend to interest growers in the production of good seed as well as in the use of the same.

TABLE I.—*Combined Sacramento, Vallejo and San Francisco Grain Inspection Certificates.*

Month	Corn	Oats	Rice	Wheat	Grain Sorghums	Barley	Beans	Miscellaneous Grain	Total
January	26		7	32	3	1			69
February	43		64	18	15	5			145
March	37		36	1	8				82
April	11		176	14					201
May	40		147	24	2				213
June	29		111	40	12	1			193
July	27		6	79	9	11			132
August	23		1	83	9				116
September	38	2	6	120	5				171
October	43		187	69	2			1	302
November	32		492	80	4	2			610
December	62	1	341	45	16		2		467
Totals	411	3	1,574	605	85	20	2	1	2,701

TABLE II.—*Grain Inspection Certificates.*

Month	Sacramento	Vallejo	San Francisco	Total
January	7	61	1	69
February	46	68	31	145
March	37	44	1	82
April	177	23	1	201
May	147	64	2	213
June	112	81		193
July	10	104	18	132
August	4	105	7	116
September	6	160	5	171
October	192	107	3	302
November	493	115	2	610
December	346	115	6	467
Totals	1,577	1,047	77	2,701

TABLE III.—*Total Number of Samples in Laboratory for Test and Analysis and the Actual Number Conducted During 1925.*

RECAPITULATION.

	Total					Public Service					Fee					Inspection and Investigation			
	Total	Purity	Germination	Identification	Examination	Total	Purity	Germination	Identification	Examination	Total	Purity	Germination	Identification	Examination	Total	Purity	Germination	Identification
Forwarded January, 1924	108	108	102	....	....	51	51	48	....	....	47	47	44	....	....	10	10	10	....
Received 1925	3,503	1,772	3,080	202	32	1,868	1,086	1,686	22	19	1,336	617	1,272	8	13	299	69	122	172
To test 1925	3,611	1,880	3,182	202	32	1,919	1,137	1,734	22	19	1,383	664	1,316	8	13	309	79	132	172
Forwarded January 1, 1926	93	70	69	23	....	25	25	24	....	....	15	15	15	....	....	53	30	30	23
Tested 1925	3,518	1,810	3,113	179	32	1,894	1,112	1,710	22	19	1,368	649	1,301	8	13	256	49	102	149
Canceled	10	10	10	....	....	....	....	....	....	....	....	....	....	....	....	10	10	10	....
Actual samples tested	3,508	1,800	3,103	179	32	1,894	1,112	1,710	22	19	1,368	649	1,301	8	13	246	39	92	149

TABLE IV.—*Total Number of Samples of Seed Received for Test and Analysis during 1925.*

1925	Total					Public Service					Fee					Inspection and Investigation			
	Total	Purity	Germination	Identification	Examination	Total	Purity	Germination	Identification	Examination	Total	Purity	Germination	Identification	Examination	Total	Purity	Germination	Identification
January	295	144	204	72	3	179	116	160	....	3	45	28	44	1	....	71	....	....	71
February	249	132	218	2	3	182	99	154	2	3	67	33	64	....	....	....	....	....	....
March	224	125	215	....	3	166	91	157	....	3	58	34	58	....	....	....	....	....	....
April	152	80	133	5	3	111	55	95	4	3	29	19	28	1	....	12	6	10	....
May	115	52	103	9	....	81	39	76	2	....	25	11	25	....	....	9	2	2	7
June	151	52	143	2	....	103	32	96	2	....	46	18	45	....	....	2	2	2	....
July	250	81	235	8	1	135	44	128	1	1	109	37	106	2	....	6	....	1	5
August	309	132	277	2	1	171	79	155	1	1	127	44	113	1	....	11	9	9	....
September	420	228	412	3	....	216	131	208	3	....	168	64	168	....	....	36	33	36	....
October	526	352	494	1	4	216	174	196	1	1	282	172	270	....	3	28	6	28	....
November	401	199	353	3	13	170	114	145	1	3	212	83	190	2	10	19	2	18	....
December	411	195	293	95	1	138	112	116	5	1	168	74	161	1	....	105	9	16	89
Totals	3,503	1,772	3,080	202	32	1,868	1,086	1,686	22	19	1,336	617	1,272	8	13	299	69	122	172

TABLE V.—*California Bonded Warehouses.*

Commodity	January 1, 1925		December 31, 1925	
	Number of warehouses	Capacity	Number of warehouses	Capacity
Dried fruit	54	303,200 tons	35	237,350 tons
Grain	24	113,917 tons	30	107,891 tons
Canned goods	20	[illegible] cases	23	4,054,800 cases
Olive oil	1	26,000 gallons	1	33,720 gallons

TABLE VI.—*Cotton Classing.*

Month	Bakersfield	Blythe	Fresno	Total
January	507	272	257	1036
February	152	5	101	258
March	10	Office discontinued	20	30
April	Office closed	Office discontinued	Office closed	
May	Office closed	Office discontinued	Office closed	
June	Office closed	Office discontinued	Office closed	
July	Office closed	Office discontinued	Office closed	
August	Office closed	Office discontinued	Office closed	
September	43	Office discontinued	16	59
October	1,618	Office discontinued	459	2,077
November	2,859	Office discontinued	1,056	3,915
December	2,281	Office discontinued	1,163	3,444
Totals	7,470	277	3,072	10,819

DIVISION OF ANIMAL INDUSTRY.

By J. P. Iverson, Chief.

The hitherto unequalled methods now applied in the control of communicable diseases are regarded by thoughtful observers as an outstanding reason for the rapid advancement of the white race. This marvelous progress in disease control and eradication so greatly benefiting the human race has produced similar beneficial results to the live stock industry.

According to recently published statistics, the monetary value of live stock in California is $183,215,570.

The Division of Animal Industry is charged with the protection of this great industry against the spread of contagious and infectious diseases. This, it will be realized, is an obligation demanding constant vigilance to detect as early as possible the appearance of a transmissible disease, and necessitates continuous preparation for immediate and vigorous action in disease eradication.

During the past year cattle scab occurred on several occasions. Texas fever was discovered in San Diego County, and a few cases of foot and mouth disease were found in deer in Tuolumne County. Fortunately, however, there is now assurance that California is entirely free of these costly diseases.

The Division of Animal Industry is alert to detect any introduction of disease. To constantly apply precautionary measures in this direction, a force of experienced veterinarians is maintained to make inspections of live stock in the field and at shipping and receiving points, such as San Francisco, Oakland, Berkeley, Los Angeles, Vernon, Colton, San Bernardino. In addition, hog feeding establishments at Colma, Vallejo, Richmond and other locations are regularly inspected.

The economic importance of the eradication of tuberculosis in live stock is now accorded more appreciation than ever before by the thinking public. This is indicated by the increased number of tuberculin tests required by live stock owners.

At present, California has three laws operating for the protection of public health and for tuberculosis eradication. These statutes are: The Pure Milk Law, Tuberculosis Free Area Law and Accredited Herd Law.

The following table will indicate the scope of the work of the Division of Animal Industry in combatting communicable live stock diseases:

Tuberculin tests	121,143
Live stock inspections at State Fair	14,141
Live stock inspections at stockyards for foot and mouth, scab, cholera, etc.	3,078,203
Cattle inspection for scabies	69,328
Sheep inspection for scabies	1,957,835
Total	5,225,152

These figures represent work accomplished by state employes in connection with the prevention, control and eradication of communicable animal diseases.

The foregoing table does not include the thousands of live stock examinations required by the many special and emergency investigations which were made during the year by the veterinarians of the Division of Animal Industry.

Foot and Mouth Disease.*

Foot and mouth disease is a highly communicable disease of cloven-footed animals. In certain countries the plague is endemic, and they can not enforce eradication measures applicable to this country.

The disease has invaded the United States several times, but in each instance drastic eradication measures have suppressed the infection. In countries where the malady is permanently established the losses suffered by live stock owners at times become appalling. The slaughter method of eradication in countries normally free from the infection has been demonstrated to be efficacious. Quarantines and treatment will not effectively control the disease, and will eventually lead to the permanent establishment of the infection in a new area.

Unfortunately, however, during the month of February, 1924, California was visited by foot and mouth disease, the infection making its first appearance in the San Francisco Bay region. Later, the disease appeared in a number of other counties, in spite of the efforts directed toward its eradication.

By the fall of 1924, the disease was entirely eradicated from all sections of the state, with the exception of an area in the Stanislaus National Forest where infection continued to appear among deer. Affected deer continued to be found in that district early in 1925. State and federal veterinarians stationed in that section throughout the year guarded the situation closely. Late in the summer of 1925 it was deemed safe to place test herds of cattle in this area, and up to the present time there has been no recurrence of the disease. However, headquarters for federal and state inspectors are still maintained at Sonora and regular inspections and observations continue.

European Fowl Plague.

Foreign communicable diseases were discovered in the United States twice during 1924; foot and mouth disease appeared in February and toward the end of the year European fowl plague was discovered in certain eastern and middle western states.

The existence of fowl plague in this country menaced the poultry industry of California. Poultry production has shown a rapid growth and in some parts of the state has attained such proportions that it is one of the leading industries in those districts. Should a dangerous communicable disease such as fowl plague appear in California, the loss to the poultry producing centers, individual flock owners and the industry would be enormous. Therefore, regulations intended to prevent the introduction of the disease have been issued.

With modern transportation, communicable diseases may rapidly spread from one section of a state to another, or from state to state. Consequently, unless proper sanitary precautions are taken, the spread may occur before those interested are aware of the existence of a dangerous disease.

---

* For a more detailed discussion of the foot and mouth disease epizootic, refer to the special report on page 135 of this issue.

In a measure, such a calamity may be avoided by conducting inspections of the poultry at points of origin or destination.

Extensive shipments of poultry from other states are regularly received throughout the year in California. Since these consignments may be assembled from various sources, it was deemed advisable to inspect carload shipments of live birds at destination. The regulations at present in effect provide that such shipments shall not be unloaded until inspected by a representative of the Division of Animal Industry.

The following table sets forth the number of cars of poultry received in California from eastern points during the year 1925:

Total Number of Cars of Poultry Shipped into California from Eastern Points During Year 1925.

	Canada	Colorado	Idaho	Iowa	Kansas	Minnesota	Missouri	Nebraska	New Mexico	Oklahoma	South Dakota	Texas	Utah	Wyoming	Total
January		2	2	1	6		3	36	1	1		8			60
February		2	1		4			33				13			53
March		2			2			26		1		22			53
April		2			1			18				28			49
May		3			1		3	18				16			41
June		3	1		2		3	24		2		3	2		41
July		2	1			1	1	27		1		2	3		38
August		2			3			39		1		5		1	51
September		8	2	3	4			70		1	3	6			97
October		3	1	3	3		1	70		2	4	1			88
November	1	5	4		5		5	81		1		4			106
December		10	2	2	10		2	88		4	2	19		1	140
Totals	1	44	14	9	41	1	18	530	1	14	9	127	5	2	817

The Animal Pathology Laboratory.

It is sometimes said that the medical profession is built upon a pyramid of three stages, diagnosis, prognosis and treatment, diagnosis being the foundation. If an early and accurate diagnosis is made, appropriate treatment or the necessary sanitary measures automatically follow. It is acknowledged that a sure and quick diagnosis is of paramount importance in the control of any infectious disease, whether it be of man or animals. Medical men are trained to detect and interpret symptoms, but it remains for a laboratory to actually determine by various means, and frequently with the aid of a microscope, the causitive factor of a diseased condition, and to demonstrate beyond question the accuracy of a clinical diagnosis. It is true that some conditions can be diagnosed in the field, but a laboratory is essential for the differentiation of certain transmissible diseases. A well equipped pathological laboratory is, therefore, of great importance not only to the Division of Animal Industry, but to the live stock interests as a whole, and especially to the owner who is sustaining losses.

The promulgation of quarantines, in some instances, is based on the findings of the pathological laboratory. These quarantines of necessity must in some instances be very stringent even at the risk of considerable loss to the owner. In an instance of this nature, before a quarantine is issued, the diagnosis should be supported with indisputable evidence that a suspected disease actually exists. The Division laboratory is maintained to supply the department with this required information. Instances can be cited where the mere showing of accumulated evidence has prevented useless legal entanglements.

At the present time, the State Department of Agriculture is employing a large force of meat inspectors in the enforcement of the Meat Inspection Law. These men are veterinarians, and while they are capable of detecting gross pathological lesions, they are confronted from time to time with conditions requiring them to obtain decisions from a laboratory in order to substantiate their diagnoses. In some instances meat inspectors send specimens to the laboratory for examinations prior to rendering final judgment on meat food products.

The Division of Animal Industry is charged with the suppression and eradication of infectious diseases among live stock. Where losses are being sustained it is the duty of the division to investigate and, if possible, ascertain the cause. Consequently, frequent trips are made into the field by the laboratory workers, either to confer with other veterinarians, or to make investigations of infectious diseases. As an illustration of some of the conditions found while investigating these losses, the following is cited: In 1925, losses were found to be due to poisoning by arsenic, copper sulphate, milkweed and larkspur. Contagious diseases also demanded field investigations by the laboratory workers. The chemists and botanists in the employ of the Department have been of great assistance in making chemical analyses of suspected cases of poisoning, and in identifying poisonous plants.

In 1915 the Pure Milk Law was enacted necessitating the tuberculin testing of a large number of dairy cows supplying dairy products to be consumed raw. This testing grew steadily, and in 1922 it was deemed economical for the Department to prepare its own tuberculin. Since then, nearly all tuberculin required for testing under the provisions of the Pure Milk Law has been prepared in the department laboratory.

Tuberculin is a product prepared from a liquid broth on which tuberculosis bacilli have been grown for a considerable time. It is the most reliable agent known for the detection of tuberculosis in live stock. The suppression of tuberculosis, as well as the protection of the raw milk supply, in a large measure, depends upon the use of this product. The method of preparing it is the same as that applied by the Bureau of Animal Industry of the United States Department of Agriculture. To accomplish the desired results it is necessary to provide the official veterinarian engaged in the enforcement of the Pure Milk Law with a tuberculin of known potency.

During the year 1925, there were 103,319 animals tested under the Pure Milk Law. For this work, the laboratory supplied 11,422 vials of tuberculin comprising 29,580.5 c.c., at a nominal cost to the department.

In the past year the laboratory workers made seventy-eight field investigations which average from one to two days, and inspections of all exhibition animals were made daily at the State Fair.

The following table shows the extent of diagnostic work in 1925:

Cattle diseases.

Anthrax, 12 examinations.
Blackleg, 14 examinations.
Cattle scabies, 16 examinations.
Red water, 1 examination.
Ringworm, 2 examinations.
Tick identification, 2 examinations.
Miscellaneous, 6 examinations.

Hog diseases.

Scalded, 1 examination.
Measly, 1 examination.
Miscellaneous, 1 examination.

7 examinations for sheep diseases.
3 examinations for duck diseases.
2 examinations for chicken diseases.
2 examinations for turkey diseases.
1 examination for dog diseases.
4 examinations for forage poisonings.
7 examinations of feed.

Anthrax.

Anthrax is a highly contagious and infectious disease affecting cattle, sheep, horses, mules, hogs and many other species of animals. It is also transmissible to humans. The mortality rate in anthrax outbreaks is usually very high. The organism invades the blood stream producing a pronounced septicemic condition. Innumerable anthrax germs are contained in the blood of infected animals, and for this reason the skinning of carcasses infected with the organism is extremely dangerous.

When anthrax organisms are exposed to conditions unfavorable to their growth, they assume a spore form which is highly resistant to heat and cold. These spores may remain in the ground for a long period and still be capable of infecting animals. Due to this ground contamination, there are many districts known to the Division of Animal Industry where anthrax recurs frequently. That no large outbreaks have occurred in recent years is due to the promptness of the Division of Animal Industry in quarantining cases, and in causing the burning or deep burial of all dead animals. By strict enforcement of these quarantines it has been possible to prevent additional territory from becoming infected. In these contaminated areas, losses may occur at any time, but information accumulated shows that infections appear principally during the hot summer months when feed is dry and short.

In districts where anthrax has never been known to exist, live stock losses should not be attributed to this disease until the diagnosis is confirmed by careful and accurate laboratory examination. Promiscuous vaccination of live stock against this disease should not be encouraged as it may lead to serious consequences, and may even be the means of establishing new areas of infection.

Blackleg.

Blackleg is an infectious disease to which cattle up to a certain age are highly susceptible. It is transmissible to sheep and hogs and some authorities report its occurrence in horses. It is a well known fact that cattle from six months to two years of age possess an extremely low resistance to this infection. However, losses have been encountered in very young calves and in older cattle.

The first symptom generally noted in this malady is a pronounced lameness, and as a rule, death follows in from twelve to twenty-four hours. Ordinarily, under range conditions, animals are found dead before the owner is aware that anything is wrong. This disease is not spread by direct contact, i. e., from one animal to another, but it is contracted by the germ entering either through an abrasion of the skin, or by the animal eating food contaminated with the organism. If the disease is due to wound infection, there will be noted during the period of illness, and particularly after death, a large swelling over the affected quarter, and when the hand is lightly passed over it, a sound will be noted resembling that produced when crumpling paper. This condition is caused by an accumulation of gas in the underlying tissues. After a short time, the gas will permeate all the tissues of the cadaver. All parts will show great distention, giving to the carcass a characteristic wedge-shaped appearance. The legs are apt to be stiffly extended and elevated.

Where the animal has picked up the infection through eating contaminated food, the lameness may be entirely lacking, and post-mortem findings resemble those of anthrax. In such cases, care must be exercised in arriving at a diagnosis, since a general hemorrhagic condition will be noted and a great deal of gas encountered.

The organism causing this condition is a spore bearer. The spore is formed when conditions for propagation are unfavorable, and, like all germs of this type, is very resistant to the extremes of weather temperatures. Consequently, it will live in the ground for a long period, and the range or pastures where cattle have died from this infection must thereafter be considered contaminated. For this reason, all carcasses should be burned where they lie. No susceptible cattle should be turned on these areas until they have been properly immunized. By the use of either Blackleg aggression, filtrate or vaccine, cattle can be rendered immune to this disease, permitting them to graze on infected territory without fear of serious losses.

Blackleg is widespread in California, but the greatest losses are suffered in the mountain districts.

Cattle Scabies.

Cattle scabies or scab still continues a menace to California live stock. During the past three years there have been annual outbreaks of the disease in California which have been caused by importations of affected animals from other states. No one can be held responsible for these invasions since there are conditions when there is no way of telling when cattle have been exposed or have a very slight infection. The disease has become rather well established in several of the mountain and middle western states, and from there has been transported to California several times. Prompt action on the part of the State Department of Agriculture has prevented any spreading of the infection after an outbreak has occurred.

California must import a large number of cattle every year, and the pest may be introduced again at any time. For this reason, owners of cattle should familiarize themselves with the appearance of the disease, and should promptly report all suspicious cases.

Cattle scab is a contagious skin disease of cattle which is caused by a mite. There are two distinct forms of the disease which do serious damage, and for this reason it is imperative that an accurate diagnosis be made before treatment is undertaken. The most prevalent form, generally known as common scab, is caused by a mite known as the *Psoroptes bovis*. This mite lives and feeds upon the skin of the infected animal, producing an intense itching. The affected part also frequently becomes devoid of hair. Typical scab patches soon appear. These are the result of the skin abrasions made by the animal rubbing the infected areas. The infection generally starts on the neck or the withers, and the skin over these areas takes on a wrinkled, inflamed, moist, leathery appearance. As the disease progresses, the whole body may become involved. The animal is very restless and loses weight rapidly. In dry weather the lesions will show a tendency to heal, but as the rainy weather comes on they will reappear over an extensive area. Many stockmen think that if lice are found, no mites will be present, but this has been disproved. The department has demonstrated, in several instances, that the lice and mites may infest an animal at the same time. Two dippings in a good lime-sulphur dip, as a rule, are all that is necessary to cure infected animals.

The other form of scab found in cattle is caused by a mite called the *Sarcoptes bovis* and is rather difficult to cure. This mite burrows into the skin, where it lays its eggs. The young mites hatch in about ten days, migrate to the surface, and there start new burrows. These parasites generally attack the tender parts of the skin where there is naturally not much hair, such as the inner surface of the thighs and around the root of the tail. The surface lesions are similar to those of common scab, but spread more slowly. However, in time they will extend over the entire body. The spread from animal to animal is generally slower than the Psoroptic form.

Five to seven dippings in a lime-sulphur solution are required to eradicate these mites.

During the year 1925 there were examined for scab infection 59,328 head of cattle and 20,348 were dipped.

Forage Poisoning.

When one thinks of forage poisoning, he usually associates it with a food that is moldy. Laboratory experiments, however, have shown that the mere presence of mold on food is no indication that the food is poisonous. Nevertheless, mold in feed is an indication of spoilage. In a case of forage poisoning an animal may show nervous symptoms with accompanying paralysis. When a horse is so affected the condition is sometimes called spinal meningitis, while the symptoms manifested from the same cause in a cow are usually referred to as pseudorabies. Losses from such conditions are usually curtailed by a change of feed. The feeding of decaying beets and garbage has led to losses in cattle. Serious results have also occurred in horses fed on spoiled hay or forage.

Metallic Poisoning.

Another class of forage poisoning is caused by the heavy metals. Of these, arsenic and lead are the forms most commonly encountered. As a rule, such poisons occur in cattle and sheep. These losses are practically all preventable, if the owner will exercise a little care and remember that dairy cows have a tendency to lick various objects that are bright and attractive. Lead poisoning, when encountered, usually results from eating lead scalings which have been left where they are accessible to the family cow. It has been known to occur in cattle and hogs from licking a fresh coat of paint applied to a building or barnyard equipment. Arsenic poisoning has been produced in live stock permitted to graze on plants sprayed with arsenic preparations to destroy pests or plant growth.

Poisonous Plants.

Among the natural grass feeds in California are several poisonous plants which cause annual losses to the live stock industry. The most common of these are larkspur, milkweed, deadly nightshade, water hemlock, lupine, loco, laurel and death camas.

Glanders.

Glanders is a communicable disease of horses, mules and the cat family and is also transmissible to man.

In some advanced or acute cases, a clinical diagnosis of the malady can be made without difficulty. However, this is not always possible when dealing with some of its chronic forms or in the early stages of the disease.

Two forms of glanders are commonly observed, i. e., chronic and subacute. In the horse the disease generally assumes the chronic form, while in the mule the subacute form is usually observed.

The application of the mallein test is a reliable method of detecting obscure cases. It is a routine practice in the army to apply this test to horses and mules before they are purchased.

According to the California statutes, animals affected with glanders must be destroyed. When this law was enacted, the disease was prevalent in California. However, energetic sanitary police measures, supported by public sentiment, have almost eradicated the infection. At the present time the disease is of rare occurrence in California.

The following table indicating the number of animals destroyed and the number tested with mallein for glanders illustrates the results accomplished in the control of the disease:

Year	*No. tested*	*No. reacted*	*No. destroyed*	*Negative*
1920	579	40	59	539
1921	516	48	62	468
1922	561	51	54	510
1923	473	53	66	420
1924	214	25	30	189
1925	389	36	52	353

Hog Cholera.

Hog cholera is a disease that has been responsible for enormous losses to the swine industry. Practically every state in the Union has been visited by this deadly plague. In California at the present time the situation is very encouraging. For several years the California

Department of Agriculture and the Federal Bureau of Animal Industry have been advocating proper hog sanitation and as a result there has been very little hog cholera in this state during the past year.

Hog cholera manifests itself in two forms—chronic and acute. Usually, it is the acute form that is encountered. As a rule, the first symptom noted in an infected herd is the failure of some of the animals to come to their feed. They hide away and, when possible, will bury themselves beneath any available straw or other litter. They will have a high temperature and frequently diarrhœa, followed by death in from one to five days. The spread throughout the herd is very rapid and if allowed to run a few days the death rate will be enormous. Several instances can be cited where entire herds have died due to delay in diagnosis.

Fortunately, Doctors Dorset and McBride of the United States Bureau of Animal Industry have devised a method whereby permanent immunity may be conferred to susceptible hogs. As a result the disease can now be controlled if treatment is administered under proper supervision. In areas where the disease is prevalent the serum and virus method of vaccination has proved to be the most efficacious means of preventing losses.

The feeding of nonimmune hogs with garbage has resulted in serious losses to swine raisers engaged in this pursuit.

In case of a suspected outbreak of cholera, the following procedures are suggested:

1. Immediately notify the Department of Agriculture, Division of Animal Industry, at Sacramento.
2. Obtain an early diagnosis.
3. Burn or bury deeply all dead animals.
4. If disease is present, properly vaccinate all susceptible hogs.
5. Thoroughly clean and disinfect the premises and introduce only immunized animals.

Internal Parasites.

Losses in animals occur annually from infestations of internal parasites. Lung worms in certain areas take their yearly toll of sheep, hogs and calves. Liver flukes in cattle lead to the condemnation of large numbers of livers in state and federal inspected abattoirs. The ascarides, or large round worms, are responsible for yearly losses of live stock. The blood sucking strongylus worms do considerable damage to the horse population in the low swampy areas. Head grubs in sheep and deer are responsible for many deaths. In the east and middlewest, serious losses result from stomach worm infestations in sheep.

Lung Worms.

Lung worms, as the name implies, inhabit the lungs of live stock, and cause considerable loss in certain districts in California. Almost all classes of live stock in an infested area are subject to this invader. These worms live in the bronchi and air sacs of the lungs. The affected animal usually shows an unthrifty condition, and develops a very pronounced cough. Death is caused by asphyxiation due to the presence of large numbers of worms in the lungs.

Liver Flukes.

In the United States, this parasite is found on low swampy ground. Cattle, however, are relatively resistant to invasion and actual death losses are very slight. In sheep, however, the mortality rate is quite high. Yet, in California, the infestation is not met with as commonly in these animals as in cattle because sheep in this state are raised principally on the high table lands.

These parasites invade the liver of the affected animal, and they inhabit the bile ducts where they set up inflammatory processes. Because of the abnormal condition of the liver and the presence of a number of the parasites, this organ is unfit for food, and is, therefore, condemned in slaughtering establishments where inspection is maintained.

Ascarides, Round Worms.

The principal loss occasioned in swine by these parasites occurs in young pigs. The infestation is picked up from the droppings of other infested animals which have contaminated the premises. The technical name of the worm is *Ascaris lumbricoides.* The adult worms inhabit the small intestines, and are sometimes present in such large numbers that the organ is completely plugged.

The larval forms of this parasite migrate from the intestines to the blood stream and are carried to various organs of the body, such as the liver, heart and lungs, where they may remain for some time before they are expelled from the body. It is, therefore, evident that the worm is capable of producing serious harm in swine.

At times, the infestation is so great that a large percentage of the infested pigs die. Hogs so affected are unthrifty in appearance, and will not produce sufficient gain for the amount of feed consumed.

Recent scientific investigation indicates that humans are subject to invasions of this parasite.

In chickens, the round worm, *Heterakis inflexa,* is responsible for large losses. The combs and wattles become very pale, and the birds have a tendency to "go light." Proper egg production is thereby interfered with.

For many years, blackhead in turkeys has been a serious handicap to the raiser. According to a recent publication this disease is transmitted by a round worm known as the *Heterakis gallinae.* It now appears that by controlling this worm infestation, the losses from blackhead are reduced.

Grub in the Head in Sheep.

For the past few years, losses in sheep have occurred in certain districts in California. The Division of Animal Industry has been called upon to investigate some of these losses. The animals generally show a pronounced nasal discharge and sneeze frequently, at which times there may be discharged from the nostrils a considerable quantity of mucous. As the condition advances, a decided loss of flesh is noted; not infrequently followed by death. In some cases, a profuse greenish diarrhea has been noted. Up to the present time, in every case of this nature, the department has been able to demonstrate a parasite in the upper nasal passages and in the frontal sinuses. This grub is technically known as the *Oestrus ovis,* and the condition is called "grub in the head." The loss of sheep in some of the infected bands has run well over fifty per cent. While there seems to be some doubt that this grub is responsible for the heavy losses sustained, the Division of Animal Industry holds that in a large number of cases this parasite is the primary factor responsible for a train of serious complications observed in sheep heavily infested with the grub.

Sheep Scabies.

California is favorably adapted to sheep raising and for several years the industry has prospered. However, losses may be experienced in this business if constant attention is not given to the control and eradication of various transmissible sheep diseases. In the early days of sheep raising, scabies or scab was widespread and caused very heavy financial losses. In that period it was difficult to maintain a flock free from the disease, and sheepmen were frequently obliged to dip their sheep. Since the state and federal authorities have taken charge of scab eradication, one of the sources of greatest loss has been nearly eradicated.

Sheep scab is a skin disease caused by a small parasite known as *Psoroptes ovis.* This mite lives and feeds upon the skin of the sheep and produces an intense itching, causing the animal to scratch and bite at the affected area and pull out the wool. Following the resulting abrasions, scabs or crusts appear, and on close examination, the mite *(Psoroptes ovis)* can be found. The disease spreads rapidly, and in a short time causes a heavy loss of wool. In an affected flock, lambs seem to suffer most and will not fatten properly.

The state and federal authorities recommend several dips as a cure, and dippings of scabby or exposed sheep should be supervised by a state or federal inspector. This procedure, in the long run, will prove economical to the owner, since experience has shown that unsupervised dippings frequently fail to effect a cure.

An important factor in the handling of an infected band is the necessity of dipping every sheep not only once but the second time, as required in order to exterminate the mites. Where infection is present, two dippings in lime and sulphur will generally effect a cure except in extremely severe cases when the animals should be dipped three times. Even with the exercise of every precaution bands occasionally "break" after careful dippings.

During 1925, 1,957,835 sheep were inspected for scab and 50,586 were dipped.

Texas Fever.

Texas fever is sometimes referred to as bovine malaria since in some respects it resembles human malaria. It is caused by a protozoan parasite which lives in the blood stream and destroys the red blood corpuscles. This parasite is transmitted from one animal to another by the bite of the tick commonly known as the Texas fever tick, *Margaropus annulatus.* The corpuscle-destroying parasite introduced into the blood stream by the bite of this tick is called *Piroplasma bigeminum.* The blood from cattle which contains this parasite will, if introduced into susceptible cattle, reproduce the disease.

The complete life history of the Texas fever tick has been worked out, an important part of which is as follows:

The female tick, after engorging herself with the blood of an infected animal drops to the ground where in about ten days she lays her eggs in some sheltered place. At the end of ten to fifteen days, according to the weather, the young ticks hatch and crawl upon the blades of grass or on the low limbs or twigs of brush. At the first opportunity, they attach themselves to passing cattle and begin feeding. In this manner, the infection is transmitted from animal to animal, so that eradication of this disease depends upon the extermination of the tick.

At one time California was extensively infested with this tick. When the federal department and the state undertook eradication measures in 1906, the infestation extended from the Mexican border to the northern boundaries of Merced and San Luis Obispo counties.

At that time many dipping vats were erected and systematic dippings inaugurated. During these operations it was found that dipping cattle in a special preparation of arsenic was a very affective means of killing the ticks with but very little danger to the animals. In 1916 the work was completed and California enjoyed the distinction of being one of the first states to successfully eradicate a heavy infestation.

In 1918 tick infestation was discovered in Kings County and eradication effected within a year.

Late in 1925 a small area in San Diego County again became infested. A number of cattle died, and Texas fever ticks were found on one ranch. A careful investigation to determine the source of this outbreak revealed that some Mexican cattle had broken through the international fence. Immediate steps were taken to clean up this area, and systematic dippings of the affected cattle are well under way. To date, there has been no spread from the original premises.

This recent infestation illustrates the necessity of constant vigilance to keep California free from this pestilence and from dangerous foreign diseases.

Tuberculosis.

Tuberculosis is one of the oldest diseases known to man. Hippocrates, father of all medical science, spoke of it as "The Pearly Disease." While this malady has received extensive consideration even from the earliest times, it was not until 1882 that Robert Koch discovered the organism responsible for this plague, and was successful in cultivating it artificially. To Doctor Koch is also due the credit of preparing the first tuberculin which, for a time, he regarded as a curative agent. Time has disproved the value of this preparation as a cure, but its use for that purpose resulted in the discovery that tuberculin is the only reliable diagnostic agent for bovine tuberculosis.

There is, perhaps, no other disease on which a greater amount of work has been done, but as yet no specific remedy for its cure has been discovered. The only way to effectually control the ravages of this malady in cattle is to test them with tuberculin, eliminate all reactors, clean and disinfect the premises and restock with clean cattle only, preferably, from known healthy herds.

Tuberculosis among live stock was unknown in this state in the early days, but owing to the increased demand for dairy products, more and better cows were introduced from other states and foreign countries. It is probable that these animals introduced the infection and as it is only in recent years that satisfactory sanitary measures have been devised for the handling of this pernicious disease, the previous lack of precautionary measures permitted the original infection to spread from these few animals.

The spread of the disease became so alarming that in 1915, the Pure Milk Law was enacted. This legislative action was intended as a public health measure rather than an effort toward eradication. According to this law, all dairy products sold or offered for sale in the raw state for human consumption must come from non-reacting tuberculin tested cows. The amount of testing occasioned by this law demonstrated the necessity for control and eradication measures. As a result, in 1921, the legislature passed two eradication measures, the Accredited Herd Law and the Tuberculosis Free Area Law.

The Pure Milk Law.

As has been stated previously, this law was enacted as a protection to the health of the public and was not intended as an eradication measure. The work has grown from year to year, and as the population of the state increases, this branch of the work will increase. Not only has it provided dependable protection to the puble at large, but it has also served to locate the areas of greatest infection. With many people, the idea prevails that it is impossible to keep a herd free from tuberculosis. The results, however, clearly indicate that herds may be "cleaned up" and maintained free of the disease. This, of course, is impossible unless the department is extended the confidence and cooperation of the owner.

In spite of the fact that this measure was primarily intended as a health measure, it has served to check the spread of tuberculosis inasmuch as a large percentage of reactors found in raw milk herds find their way to the slaughterhouse.

Following is a tabulation of the amount of Pure Milk Testing done in 1925:

Herds, 10,746.
Herds of 10 animals or less, 8530.
Herds of 10 animals or less free, 7776.
Herds of more than 10 animals, 2216.
Herds of more than 10 animals free, 1006.
Number of animals tested, 103,319.
Reactors, 5731.
Suspects, 876.

Accredited Herd Law.

In 1921, the legislature passed the Accredited Herd Law to permit the Department of Agriculture of this state to cooperate with the United States Bureau of Animal Industry in the eradication of tuberculosis from purebred herds of cattle in California. Under this law the owner of a purebred herd may, at his option, request that a tuberculin test be applied to his animals. By signing an agreement with the state and federal authorities to observe certain sanitary precautions, the test will be applied and his herd placed in the process of accreditation. When his cattle have passed two annual or three semi-annual tuberculin tests and no reactors are found, the herd is then fully accredited, and so acknowledged in a federal-state certificate presented to the owner.

Any animal reacting to the test is branded with the letter "T" on the left jaw and slaughtered in an abattoir where federal or state meat inspection is maintained.

The owner of an accredited herd is benefited not only because he is able to maintain a herd of cattle free from tuberculosis, but because he may ship anywhere in the United States without the inconvenience of having a test applied immediately prior to such shipment. Accreditation also aids in the sale of his cattle, because he is permitted to sell milk or products thereof in the raw state, if he so desires.

Since this law became effective in 1922, there has been an increased demand for this testing each year as shown by the following tabulation:

Year	*Number in process of accreditation*		*Number fully accredited*	
	No. of herds	*No. of animals*	*No. of herds*	*No. of animals*
1922	58	4855	0	0
1923	86	6758	24	1240
1924	102	7237	44	2253
1925	96	7321	74	4387

From the above table, it will be noted that tuberculin tests on 11,708 animals were required during 1925.

Tuberculosis Free Area Law.

This law provides a federal-state cooperative plan for the systematic eradication of tuberculosis in counties asking for this work. Its application is wholly optional and is undertaken in any eligible county from which a request for its benefits is received through the local board of supervisors. The state and federal governments will then place men in that district to make a survey to determine the extent of tuberculosis infection within its boundaries. If not more than ten per cent of the cattle are affected, then eradication measures can be applied. When the infection is reduced to five-tenths of one per cent or less, the county is then declared by the federal government to be a modified tuberculosis free area.

While the original survey is being made, and after the county has been declared an eradication area, all cattle reacting to the test are branded on the left jaw with the letter "T", and are either slaughtered within the county under inspection, or taken to federal or state inspected abattoirs outside of the area.

It is quite obvious that this is a progressive eradication measure. Its points of benefit are as follows:

1. The centers of infection are revealed.
2. Infected animals are removed, thereby stopping the spread.
3. The introduction of new infection is prevented.

At present, California has two Modified Accredited Areas: Modoc and Lassen counties, and they are to be congratulated for the progressive spirit they have manifested in successfully carrying out this plan.

On September 15, 1925, Tehama County launched a similar systematic method of ridding itself of this disease. The work is now well under way, and present figures would indicate that there are less than three per cent of infected cattle in that county.

The beneficial effect of this work is not confined alone to these cooperating counties, since all cattle in surrounding counties entering these districts for summer feeding must be tested, and any reactors found are not permitted to enter. During 1925, 11,831 cattle destined to these areas were tested. Fifty-four of them reacted and were not allowed to enter eradication areas.

At the present time, Los Angeles is importing about 2000 dairy cows every month. Since Los Angeles County now has an ordinance prohibiting importation of dairy stock unless they come from herds that are less than ten per cent affected, a large percentage of the cattle buyers are forced to seek animals outside of California for replacement of stock. This money should remain in California, and those counties progressive enough to undertake area eradication will profit by this demand.

The following table shows the amount of eradication work done in 1925:

County	*Animals*	*Reactors*
Lassen	3,560	17
Modoc	7,363	140
Tehama	4,768	140
Prior to entrance	11,831	54
Totals	26,522	351

The following tabulation shows the number of tuberculin tests conducted in California during 1925, and includes all three branches of the work:

	Animals tested	*Reactors*	*Suspects*
Pure Milk Law	103,319	5,731	876
*Accredited Herd Law	13,691	192	25
*Free area	15,674	297	9
*Prior to entrance	11,831	54	
*Miscellaneous tests	698	78	
Totals	145,213	6,352	910

* Includes tests made cooperatively by federal and state employees.

Dairy and Milk Inspection.

This branch of the service is discussed in detail elsewhere.

In addition to regular activities veterinarians of the Division of Animal Industry in connection with the control of transmissible diseases, also make inspections of dairies and dairy products in many districts and in some sections of the state devote considerable time to this work.

The Division of Animal Industry endeavors to be of service and assistance in maintaining the standard of quality of dairy products in California.

MEAT INSPECTION.*

The California public shows a sufficient appreciation of the need for meat inspection to remove any doubt concerning the future growth of the work.

Its rapid development in the four years since the law became effective has necessitated the employment of inspectors with special training in meat inspection. Therefore, at this stage of the work, before it should reach a point where its rapid growth may impair its efficiency, it has been deemed wise to divert the efforts made in promoting its growth to the necessity for stabilizing the growth already made and bringing the plants now under state inspection up to the highest standard with uniform methods of ante and post-mortem inspection. For this purpose two traveling inspectors have been added whose training was received in the federal meat inspection service. Their efforts are bringing good results, the improvement in the California State Meat inspection service being already apparent. This will give a solid foundation for the great superstructure that is already assured by the attitude of the public.

---

* By George Gordon, Superintendent Meat Inspection Service.

Certain plants in various parts of the state which are best suited to the purpose are being used as training stations for future inspectors, and as uniform methods become more firmly established in the work such preliminary training can become more rigid and exacting, thus lifting the standard ever higher.

Approximately three and a half million dollars have been spent by slaughterers to date in the construction of new buildings, the remodeling of old plants, and the installation of necessary equipment. At the present time it is known that over five thousand retail markets in California are selling state inspected meat, showing not only an increase over previous reports but the evident support given by the public to the firms operating under state supervision.

The following figures indicate the number of animals slaughtered under state inspection during the past year, and also the carcasses and parts of carcasses condemned for various diseases and other conditions that render meat unfit for human consumption:

	Animals passed ante-mortem.	*Animals retained ante-mortem.*	*Animals inspected ante-mortem.*
Cattle	137,178	249	137,427
Calves	148,700	142	148,842
Sheep	136,098	31	136,129
Hogs	128,707	52	128,759
Goats	2,142	0	2,142
Total	552,825	474	553,299

	Animals passed post-mortem.	*Animals passed for lard, etc.*	*Animals condemned post-mortem.*	*Animals inspected post-mortem.*
Cattle	134,744½	33	2,904½	137,682
Calves	154,840	0	867	155,707
Sheep	137,428	0	395	137,823
Hogs	128,246	10	1,038	129,294
Goats	2,170	0	17	2,187
Total	557,428½	43	5,221½	562,693

	Animals condemned for tuberculosis.	*Animals condemned for various other diseases.*
Cattle	2,568	369½
Calves	88	779
Sheep	3	392
Hogs	871	177
Goats	0	17
Total	3,530	1,734½

Number of parts condemned.	
Cattle	29,269
Calves	655
Sheep	18,675
Hogs	30,604
Goats	29
Total	79.232

Number of pounds condemned (parts and carcasses.)	
Cattle	1,889.648½
Calves	64.084½
Sheep	62,941½
Hogs	319.177½
Goats	912½
Total	2,336.764½

Processed report.	
Beef	733.376 lbs.
Veal	26.130 lbs.
Swine	1.368.395 lbs.
Sheep	30 lbs.
Sausage	2.790.470 lbs.
Miscellaneous	202,625 lbs.
Goat	510 lbs.
Total	5.121.536 lbs.

It will readily be seen by the above figures that there is a real need for state meat inspection. They give to anyone interested a fair idea of the vast amount of meat that would probably be sold to the unsuspecting public if the same were not condemned and destroyed in accordance with the regulations governing state meat inspection service. One would naturally infer that where inspection does not exist much meat of this kind is still being sold for human food.

CATTLE PROTECTION SERVICE.*

The expiration of 1925 marked the eighth year of the work of the Cattle Protection Service, which organization, a part of the Division of Animal Industry of the State Department of Agriculture, is charged with the enforcement of the provisions originally contained in chapter 678 of the act of May 28, 1917, and of the subsequent act of June 3, 1921, chapter 725, known as the Hide and Brand Law, and chapter 726, known as the Estray Cattle Act.

In order that the following report may show the result of the work of the service for the past eight years, it may be well first to state the reasons advanced by the cattlemen of California when advocating the passage of the present and the former hide and brand laws. Previous to the enactment of the act of May 28, 1917, (the Cattle Protection Law), brands used for the purpose of branding cattle could be recorded in the office of a county recorder. When this was done, such county recorder was required to notify the recorders of all adjoining counties, in order that similar brands might not be recorded in any of the contiguous counties. This method of recording brands was found to be entirely impractical and confusing, especially in those counties wherein no organized group of cattlemen existed to scrutinize and keep a close check on the records, thereby preventing the recording of duplicate brands. The lack of attention given to brand registration on the part of county recorders, resulting in many duplicate brands being recorded, made necessary a more centralized system of recording. Although a brand was recorded in the county, it did not prevent anyone else using the same brand on same location on animals in the same locality as the recorded brand.

Investigations made by the cattlemen of California indicated that California was far behind every other cattle-producing state in the matter of protection given to cattle owners by a properly centralized state system of brand registration, which resulted in a request for and passage of the above mentioned laws.

---

* By Arthur Hebbron, Secretary.

When consideration is given to the fact that many thousands of cattle are turned out annually on the open ranges, forest reserves and grazing areas of California, some method of distinguishing the ownership of these cattle is necessary and the use of a "fire brand" to identify such ownership has been found most expedient and practical. When such brands can be recorded, as is now being done, in one record under the supervision of a State Department, such a record can be used to prevent the theft and loss of cattle and save thousands of dollars each year to owners. A conservative estimate of the number of stock cattle grazing annually in California is 1,320,803, and the number of cattle taken from the ranges of the state annually, for immediate slaughter, is approximately 317,640 steers, 380,909 cows, 385,931 calves, 11,967 bulls and stags.

In order to prevent cattle from being shipped from the ranges without the consent or knowledge of the owner and to protect cattle producers from a considerable annual loss, a system of brand inspection is now provided. The absolute necessity for this legislation was easily apparent. Heretofore no check was made of cattle shipped from the ranges of the state and no information was available whereby it could be determined whether a person shipping cattle was in legal possession. Some shippers and buyers made no particular effort to ascertain whether or not the cattle they bought were the property of the person selling them. They accepted the cattle offered to them without question, the cattle were shipped and generally slaughtered immediately at point of destination. The hides from these cattle, taking their place in the "hide pile" with hundreds of others made any attempt to trace lost or stolen cattle generally unsuccessful. This indifference on the part of some of the cattle buyers was also practiced by some of the slaughterers in the state and cattlemen had every reason to believe that many lost or stolen cattle found their way to the local slaughtering establishment where they were illegally slaughtered.

Under the present Hide and Brand Inspection regulations, no cattle can be accepted by any common carrier, for shipment, until such cattle are first inspected for marks and brands by a duly authorized Hide and Brand Inspector, appointed by the Director of Agriculture and the rights of ownership or possession of the cattle by the shipper or slaughterer fully established, and no cattle can be slaughtered in any slaughtering establishment without such brand inspection. As a further protection, a system of hide inspection is provided to permit of a checking up and an inspection of all hides "taken off" cattle slaughtered in small slaughtering establishments too remote to permit of daily fulltime brand inspection, and hides can not be removed from place of slaughter or accepted for shipment or transportation by any person until they have first been inspected for marks and brands. In order to carry out this system of cattle and hide inspection, the brand records are of first importance, as these records show the design of a brand, the location it is to be placed on the animal, the name and address of the recorder and the place where the cattle so branded generally range. A list of these records is compiled with due regularity and furnished to inspectors, whereby they may be fully informed as to the ownership of any branded animal coming under their observation at time of inspection. To date, in California, approximately 17,500 brands have been recorded.

As a further benefit to the cattlemen, the state brand records made it possible to remedy the law pertaining to the sale of estrays. Chapter 726, an act approved June 3, 1921, requires that before any person can sell any branded cattle as an "estray" he first must give the Director of Agriculture ten days' notice by registered mail of such proposed sale, describing the brands and marks on the estray cattle, in order that the director may cause search to be made of the registered brands on file to determine the ownership of the estray cattle and give notice to the owner before date of sale, where such estray cattle may be found and claimed. The need for this law is undoubtedly appreciated and could only be enforced under the present system of brand registration. Many cattlemen now avail themselves of the opportunity to refer to the records in order to ascertain the ownership of any estray cattle they may find on their ranges and when the recorder of a brand on such reported estray cattle can be determined this office thus has been able to assist in restoring the cattle to the rightful owner. Our success in this work to date has been very gratifying.

It frequently occurs that we are asked to find the owners of cattle carrying brands that do not appear on our records. These are generally cattle branded with "irons" that are being used illegally or cattle brought into California from adjoining states, which have not been rebranded with a California recorded branding iron. At the present time we have a report of ten head of cattle so branded, which reverses the general order of things and instead of the cattle being lost, the owner can not be found. This is the result of a lack of appreciation on the part of the cattleman of the facilities offered by the Cattle Protection Service under the present Hide and Brand Law, whereby lost cattle can be recovered.

At the present time, approximately 9000 "active" brands are on the records under a system that permits of ready reference and prevents duplicate registration in any one branding district.

In order to carry out the brand inspection requirements of the Hide and Brand Law as enacted, it was necessary that a sufficient number of brand inspectors be appointed, authorized to inspect cattle and hides for marks and brands at all shipping points and to inspect cattle at all slaughtering establishments prior to slaughter. On account of the small compensation that can be earned by many of these inspectors, particularly those needed to make brand inspection in districts where a limited number of shipments of cattle originated and where the loading corrals were far apart and the slaughter houses located at some distance from the home of the inspector, some difficulty was had in securing inspectors properly qualified to perform this valuable and necessary service. A good inspector is hard to find! Reading brands, at least, is a difficult job and only men who have had experience on the range can be considered good brand inspectors. In the fall of the year when the hair on an animal is long and hanging over a brand, it is often difficult to read. An inspector should be able to read brands readily, in order that the cattle under inspection can be handled with as little disturbance as possible. Such exacting work as this and the experience necessary, coupled with the inadequate compensation offered, prevented the Department for a time securing competent inspectors, and the service was carried on under a considerable handicap, owing to incompetent and unreliable men. As the work advanced and the cattlemen began to feel the resultant benefits arising through the efforts made to enforce the law, a gratifying cooperation developed that materially assisted the Cattle Protection Service in improving its inspection force to the extent that the protection desired by the cattlemen is now being more efficiently given and our inspection force greatly improved. Our field brand inspection force is augmented by the work of a number of recheck inspectors located in the corrals at the large slaughtering centers and points of destination. These ''recheck'' inspectors check up the inspections made by the original brand inspector. This is done in order to locate any cattle reported as missing. They also render weekly reports of all cattle arriving at these points. To date 8,200,272 cattle have been inspected for marks and brands at shipping and slaughtering corrals. For this year 1,457,429 cattle were inspected for marks and brands, 1252 slaughterers licensed, 737 new brands recorded and approximately 9000 brands continued in force and 170 brands transferred.

During the year, sixty-seven cattle in one lot were stolen and shipped out of a Nevada point. The owner, after an exhaustive search in his own state, came to California and got his first information regarding the lost cattle from our inspector at Oakland, who had a complete record of the cattle, number each of steers and cows, with marks and brands, also the name of packing plant which unknowingly handled the shipment. The owner was thereby enabled to get figures of weight and price of cattle. This incident is only one of a number which shows the value of inspection of cattle shipped in from outside states for slaughter.

When the foot and mouth outbreak occurred in 1924, inspectors of this service through their knowledge of the country and cattle brands rendered valuable assistance to state and federal veterinarians in charge of work of eradication.

To estimate the value of the service performed by this inspection system would be as difficult as to estimate the number of accidents prevented by a traffic officer stationed at a street crossing. The very presence of the traffic officer often prevents accidents that might occur. Brand inspectors prevent the illegal shipment and slaughter of cattle that might and did happen, previous to the enactment of the Hide and Brand Law.

It is the aim of the Department continuously to improve its Brand Inspection Service.

BUREAU OF DAIRY CONTROL.

By J. J. Frey, Chief.

The Bureau of Dairy Control is charged with the enforcement of the General Dairy Law of California, Pure Milk Law, Certified Milk Act, Prepared Milk Act, and Pasteurized Dairy By-Products Act. It also lends its aid in the enforcement of the Containers Labeling Act in so far as it affects the dairy industry.

The functions of the Bureau of Dairy Control may be classified as follows:

I. Maintenance of uniform standards of composition and high quality for:

A—All manufactured dairy products and market milk in communities where no inspection is maintained locally.

B—Grading of market milk indirectly through the approval of local inspecting departments.

II. Promotion of honesty and accuracy in testing milk and cream for the determination of its milk fat content.

III. Regulation of labeling and advertising of dairy products and substitutes thereof.

IV. Accumulation and publication of statistics.

For purposes of administration, we find that the work with which this bureau is charged falls naturally into certain projects which are outlined as follows: Those items which have been especially stressed during the period covered by this report are printed in bold-face type.

I. Market Milk and Cream
  GRADED
    1. Certified (raw)
    2. Guaranteed (raw, past)
    3. Grade A. (raw, past)
    4. Grade B. (past)
  Ungraded—Bottle Exchange
    1. Supervision and Approval local departments
    2. **Surprise Scoring Contests**
    3. Organization New Departments
    4. Market Milk Information (regulatory)
    5. Health Department News Letter
    6. Special Market Milk Investigations (complaint service)
    City and town surveys—Los Angeles

II. Mfg. Milk and Cream
  Grading
  1. Adulteration
  2. Quality
  3. Rejected, Unfit
    1. **Direct Microscopic Counts**
    2. Alcohol Tests
    3. Reductase Tests
    4. Acidity Tests
    5. Sediment Tests
    6. Flavor and Odor
  Dairy Farm Sanitation
    1. **Sterilization of Utensils**
    2. **Clean Milking**
    3. Clean Surroundings
    4. Cooling
  Plant Sanitation
    1. **Clean, Sterile and Dry Containers**
    2. **Pasteurization**
    3. Refrigeration
    4. General Sanitation

III. Butter
  Composition
  Quality
  Labeling
  Special Permits
    California
    From other states
    Double Churning Process
      (See also below)

IV. Cheese
  Composition
  Quality
  Labeling
  Special Permits
  Information and Special Help
    California
    From other states
    Miscellaneous Varieties
    Regulatory

V. Ice Cream and Evaporated Milk and other dairy products
  Composition
  Quality
  Special permits
  Containers
  Composition
  Quality
  Labeling
    Plain, Fruit and Nut (varieties)
    Use of butter in manufacturing

VI. Imitations and Substitutes
- Licensing
- Labeling
- Advertising
- Composition
    - Manufacturers
    - Wholesalers
    - Retailers
    - Bakeries and Restaurants

VII. Sampling, weighing, and testing
- Testers—Licensing
- Checking
- Samplers and Weighers
- Samples
- Records
    - By Examination
    - By Renewal
    - Examining
    - Licensing
    - Containers, etc.
    - Official Sealed Boxes
    - Official Forms

VIII. Statistics
- Production
- Manufacture
- Values
- Interstate Movement
- Trends

IX. Federal-State Co-Operative Commercial Scoring
1. S. F. Merc. Ex. Agreement
    - Butter
    - Eggs
    - Cheese
2. Petaluma Egg Dealers Agreement
3. General Trade
    - Eggs
    - Butter
    - Eggs and Cheese

X. Legal Procedure
- Hearings
    - License Revocation
    - Prosecutions
    - Condemnation
- Suspensions
- Prosecutions
- Regulations, Rules, Official Score and Budgets, Claims, Bills, etc.
    - Preparation of Evidence

I. Market Milk.

Two notable features in connection with the market milk program of the past year have been brought out. First, there has been a marked uniform improvement in the quality of graded milk throughout, and second, the extension of the milk inspecting service to new communities through the organization of local departments has been very considerable.

At the close of 1925 the average quality of graded milk for the entire state computed according to United States official standards, amounted to 95.1 per cent in contrast to an average rating of 93.1 per cent for 1924. In 1925 individual community milk ratings above 95 per cent were secured in sixteen instances, while in 1924 this high mark occurred only six times. The fact was brought out by the thousands of complete milk examinations conducted throughout the State that the quality of graded milk in California today is far superior to the actual requirements. The average bacterial count of Grade A raw milk for the state is less than 15,000 per cubic centimeter, whereas 100,000 is permitted by law. The average bacterial count for Grade A pasteurized milk is less than 5000 per cubic centimeter, a count of 15,000 being the legal limit. This indicates that a revision of the present state standards adopted in 1915 is in order.

During 1925 ten local departments were organized and approved. In one instance approval was withdrawn, leaving thirty-seven approved milk inspecting departments, which have supervision over more than one hundred cities and towns. Over 85 per cent of all market milk in California is graded. Many requests for assistance in organization have been received from communities not having the advantages of a graded milk supply. While assistance is always rendered when requested, we have been handicapped in organization work through lack of sufficient personnel.

Grading of cream is just now being seriously considered by some of the inspecting departments and considerable progress has been made to the end that market cream may be graded and placed before the public bearing the same designations and with the same uniform high quality that has been characteristic of graded milk. In order that this might be more readily accomplished the time of two state inspectors, in cooperation with Los Angeles inspectors located in the district adjacent to Tulare, was devoted for six weeks to a special investigation which clearly demonstrated the feasibility of producing and transporting to Los Angeles cream which would consistently meet the grading requirements.

Ungraded market milk is supervised directly by the district inspectors of the Bureau of Dairy Control. This includes all cities and towns where no local inspection department is maintained. The work is principally accomplished through, and reported as city and town milk surveys. During the survey the inspector makes a thorough investigation of the condition of milk distributed in the town and the sanitary condition of the dairy producing it. Samples are taken and forwarded to the laboratory for bacterial and chemical analysis. Our next action is to correct any insanitary or unsatisfactory condition. When the work is completed a report is rendered on a special form provided for the purpose. Sixty-eight city and town surveys have been conducted and the following is a summary of the reports affecting the following cities and towns:

Town	*County*	*Condition of dairies*	*Condition of product*	*No. surveys conducted*
Jackson	Amador	poor	poor	1
Biggs	Butte	good	good	1
Oroville	Butte	good	good	1
Palermo	Butte	good	good	1
College City	Colusa	fair	good	1
Arbuckle	Colusa	good	good	1
Grimes	Colusa	good	good	1
Maxwell	Colusa	good	good	1
Princeton	Colusa	good	good	1
Williams	Colusa	good	good	1
Crescent City	Del Norte	fair	good	2
Riverdale	Fresno	good	fair	1
Willows	Glenn	good	good	1
Butte City	Glenn	good	good	1
Glenn	Glenn	good	good	1
Arcata	Humboldt	good	good	1
Korbel	Humboldt	good	good	2
Gustine	Merced	fair	fair	1
Calistoga	Napa	poor	fair	1
St. Helena	Napa	good	fair	2
Grass Valley	Placer	fair	fair	1
Lincoln	Placer	fair	fair	1
Roseville	Placer	fair	fair	1
Beaumont	Riverside	good	good	1
Banning	Riverside	good	good	1
Blythe	Riverside	good	good	1
Ripley	Riverside	poor	fair	1
San Luis Obispo	San Luis Obispo	good	good	2
Lompoc	Santa Barbara	good	good	1
Los Alamos	Santa Barbara	good	good	1
Orcutt	Santa Barbara	good	good	1
Santa Maria	Santa Barbara	good	good	1
Sutter	Sutter	fair	good	1
Meridian	Sutter	fair	fair	1
Benicia	Solano	fair	fair	1
Sonoma	Sonoma	fair	fair	1
Sebastopol	Sonoma	fair	fair	1

Town	*County*	*Condition of dairies*	*Condition of product*	*No. surveys conducted*
Geyserville	Sonoma	poor	poor	1
Healdsburg	Sonoma	fair	fair	1
Cloverdale	Sonoma	poor	poor	1
Waterford	Stanislaus	poor	fair	1
Salida	Stanislaus	fair	fair	1
Riverbank	Stanislaus	good	fair	1
Newman	Stanislaus	good	good	1
Oakdale	Stanislaus	good	good	1
Denair	Stanislaus	poor	fair	1
Crows Landing	Stanislaus	poor	fair	1
Ceres	Stanislaus	poor	fair	1
Davis	Yolo	good	good	1
Woodland	Yolo	good	good	1
Wheatland	Yuba	good	good	1

A summary of the Market Milk Specialist's report for year ending December 31, 1925, follows:

Supervision.

1. Number of milk inspecting departments approved	16
2. Number of departments having approval withdrawn	1
3. Number of departments holding state approval	37
4. Number of inspections of local departments conducted	90
5. Number of departments showing improvement	18
6. Number of inspections of laboratories	89
7. Number of dairies inspected	66
8. Number of milk plants inspected	41
9. Milk scoring contests:	
a. Number of contests held	88
b. Number of samples scored	2,498
c. Daily volume in gallons affected by contests	728,714

Organization.

1. Number of milk inspecting departments organized	8

Investigations.

1. Number of investigations conducted	31

Publicity.

1. Number of meetings attended	33
2. Number of addresses made	16
3. Number of interviews held	451
4. Number of news items published	92

II. Manufacturing Milk and Cream.

Milk grading has received great impetus by reason of the adaptation and utilization of the direct microscopic count. As a result of this work, a system of grading and follow-up work has been adapted to inspection districts in the state where whole milk is received, and several plants have been induced to take up the work on their own account. This operation has not only enabled us to definitely locate the sources of low grade materials, but has also furnished proof of these results.

A special demonstration of the uniform results which it is possible to obtain by the use of this method of grading and appropriate follow-up work on dairies, was made during the latter part of the month of May, and early part of June, 1925, by five state and two county inspectors. The following tabulation represents the results secured on the west side of the San Joaquin Valley, comprising that territory in the vicinity of Tracy to Los Banos, involving about eight plants receiving whole milk from approximately 900 producers.

MILK GRADING FOR MANUFACTURING BY DIRECT MICROSCOPIC COUNT.

First count

Total first grade patrons	326	38.58 per cent	
Total second grade patrons	335	39.64 per cent	May 21
Total third grade patrons	184	21.77 per cent	
Total graded	845		

Second count

Total first grade patrons	557	66.70 per cent	
Total second grade patrons	194	23.23 per cent	May 28
Total third grade patrons	84	10.06 per cent	
Total graded	835		

Third count

Total first grade patrons	728	75.44 per cent	
Total second grade patrons	191	18.75 per cent	June 4
Total third grade patrons	56	5.80 per cent	
Total graded	975		

Covers nine plants and about 1000 dairies.

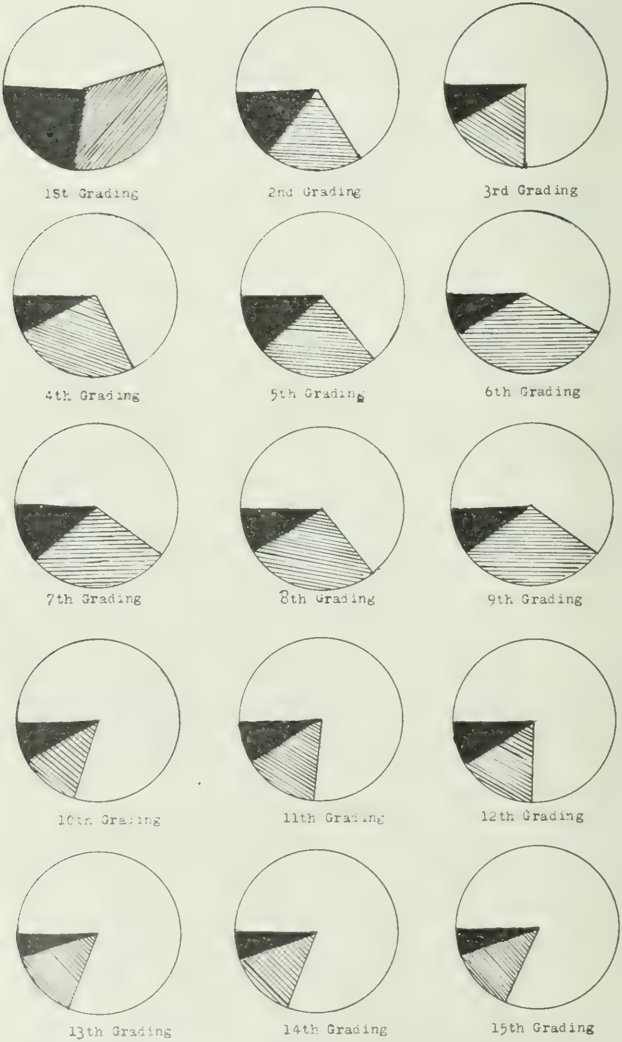
First grade	Under 1,000,000 direct count.
Second grade	Under 5,000,000 direct count.
Third grade	Over 5,000,000 direct count (condemned).

Following this demonstration the results were presented to a meeting of the managers of the plants who determined that the project should not be discontinued, and who thereupon entered into a co-operative agreement with the Department whereby sufficient funds were placed in trust in the state treasury to enable this work to be maintained on a permanent basis. The following chart indicates the average results obtained to date through the application of this method.

In the following charts, first grade milk is indicated by the white area, second grade milk by the shaded section, and third grade milk by the black area.

In addition to the very great extension of our grading activities with respect to whole milk delivered at dairy manufacturing plants, we have continued to grade milk and cream using to some extent the alcohol test, reductase test, acidity test, sediment test and flavor and odor, the latter particularly in the case of cream.

The activities in improving dairy farm sanitary methods, guided mainly by grading on receiving platforms, have continually emphasized sterilization of utensils, clean milking, clean surroundings for handling the milk and cooling. The adaptation of electricity to the dairy farm sterilizer has made rapid progress during the year under the encouragement of the sub-committee on dairying of the California Committee on the Relation of Electricity to Agriculture. Electric sterilizers are easy to keep clean, odorless, convenient and as nearly fool proof as any



1st Grading
2nd Grading
3rd Grading
4th Grading
5th Grading
6th Grading
7th Grading
8th Grading
9th Grading
10th Grading
11th Grading
12th Grading
13th Grading
14th Grading
15th Grading

Chart showing results of grading milk for manufacturing purposes. Light area is first grade, shaded area second grade and dark area is third grade milk.

equipment can be made. They are proving highly satisfactory and more economical to operate than other types.

The policy of the Department with respect to cooling has been outlined as follows: The indefinite provision of the law requiring that milk or cream shall be cooled to as low a temperature as practical naturally leaves a great deal to the discretion of the inspector. It has not been considered practical or necessary to cool milk or cream which is delivered to the plant within four hours after the milking of the herd has been completed. As a matter of fact, more harm than good is often done in such an attempt. This is particularly true if the utensils have been sterilized and the milking habits of the dairymen are clean. If these things are carelessly done, then cooling is the only method of keeping the product from spoiling, as it is an attempt to prevent the development of heavy initial contamination by physical means. Also, when cooling is necessary, it has been our custom to advise dairymen to use just as few utensils as possible, for each additional handling offers further opportunity of contaminating the product. We therefore do not advise dairymen to purchase coolers when it is possible for them to set the containers in cool water and occasionally stir the milk or cream.

Plant sanitation and its relation to quality and wholesomeness of manufacturing milk and cream has been given equal emphasis with dairy farm sanitation. Inasmuch as it has been found practically impossible to get dairymen to sterilize strainer cloths it has been uniformly recommended that their use be altogether discontinued, or if the dairyman feels that he must use some sort of cloth strainer, he is instructed to get the sterile straining cloth especially provided for this purpose and use a new one for each milking. Clean, sterile and dry containers are of particular importance not only because the interior surface is in contact with the milk more than any other equipment, thereby being the principal source of contamination, but because containers constitute a contact between dairy plant and farmer. Little can be accomplished through the pressure on dairy farmers if plants are allowed to supply them with cans which are unclean or give off foul odors after being held a few hours. The license for the operation of plants constantly allowing unsterilized or wet and dirty containers to be distributed would be revoked with dispatch.

Operation of pasteurizing equipment and accuracy of recording thermometers as an index to efficiency of pasteurization is given particular attention in connection with plant sanitation for it is found that these instruments are often abused and carelessly handled and unless frequently checked are very likely to become inaccurate or inoperative. Provision for refrigeration and storage is given due consideration as well as general sanitary conditions of the plant including pipe lines, vats, general appearance, etc. This work is under the direct supervision of district inspectors.

The problem of controlling the loss of milk bottles through failure to return them to the rightful owners after use, is, in many places, a very serious one, and requires a special form of organization to successfully combat. In order to eliminate as much as possible all loss from this source in the Los Angeles district, the Los Angeles Bottle Exchange was organized some time ago. During the past year supervision of this work was transferred to the State Bureau of Dairy Control, and a representative of this organization was deputized by this department to facilitate entrance into premises in the conduct of his work. The Exchange employs forty-three men and eight trucks, and handles millions of milk bottles each year in returning them to the rightful owners. Since this work has been undertaken it has attracted the attention of other communities and further demands have been made upon the department to extend this service.

III. Butter.

Butter at the present time is the principal form in which milk fat produced in California is utilized, although the proportion of the total amount of milkfat produced which enters into the manufacture of butter is now steadily and rapidly decreasing. It is certain, however, that for a number of years California will produce a large quantity of butter. In order that this may be altogether wholesome and most satisfying to the consuming public and in order that California may enjoy the highest reputation in the markets, a strict enforcement of the specific regulations relating to the composition and quality of butter is one of the principal projects in our program.

All butter now manufactured in the state is pasteurized and the efficiency of pasteurization recorded by appropriate registering thermometers which are inspected at regular intervals thus insuring products absolutely safe from the standpoint of public health.

Since 1922 it has been our policy to collect samples of all butter manufactured in the state once every three months. If the analyses of these routine samples indicate that the butter does not conform to the legal requirements of composition, a series of additional samples are taken and if it is found that the creamery is manufacturing butter frequently or consistently below standard, necessary action is taken in order to compel compliance with the law. This has had a desirable effect upon the butter industry of the state. In the first place it assures the consuming public of a product of great uniformity. In the second place it has made it necessary that butter makers control their process more accurately which, in turn, has made it necessary for them to study their work from a scientific point of view with the net result that butter is better in every respect as well as of uniform composition.

It has been indicated, however, that prosecution based upon too few samples from a single unit of manufacture would tend to cause overworking and consequently result in an inferior body in the manufactured article. In order to avoid this destructive influence it is now our policy to base prosecution or legal action only upon the average results of several samples obtained from the same churning, which serve to indicate whether or not the average composition of the particular unit of manufacture (or churning) was higher in moisture or lower in fat than specified by law.

When time permits, samples of butter are collected and forwarded to butter experts for commercial scores. In this way we are enabled to ascertain just where the best butter is produced and if any is of inferior quality its source is definitely known. The next step is to determine the cause of this inferiority. If due to the quality of raw materials or to improper sanitation at the plant appropriate action is taken by our representatives to correct the conditions. If, however, it is due to a faulty process in manufacture the case is referred to the extension butter specialist of the College of Agriculture. It is our purpose to bring all California butter to a commercial score of 92 or above and, by appropriate action, to protect California consumers and manufacturers against the importation of inferior, tainted or unwholesome butter from other states.

Under the provisions of the Dairy Law, butter must be labeled to indicate whether it is made from pasteurized or raw cream, but as previously stated practically all commercial butter is now pasteurized. The label must also indicate the name and address of the manufacturer, wholesaler, or retailer and the person or concern responsible for its composition and quality. In each instance the label must also indicate by the use of appropriate words whether the responsible person or concern is the manufacturer, wholesale distributor or retailer. Deceptive geographical designations on labels are prohibited.

A special double churning process has been devised which makes it unnecessary to use neutralizers in manufacturing butter from sour cream. This may be used only under special written permit from the Department of Agriculture as a safeguard against any attempt to adapt the process to the renovation of rancid or impure cream or butter.

Commercial butter scoring in cooperation with the Bureau of Agricultural Economics, U. S. Department of Agriculture, is discussed below as a special project under the cooperative agreement providing for this work.

IV. Cheese.

There are five established varieties of cheese manufactured in California. By established varieties is meant those which are specifically defined by law or regulation. These include Cheddar, Granular, Monterey, Cottage and Non-standard Jack. All of this cheese must be labeled to indicate its variety and whether made from full-cream, half-skim or skim. The designation "full-cream" is somewhat misleading and not as defining as the term "whole milk" which is more generally used to express the same quality. While California does not export any considerable quantity of cheese, yet there is a conflict here which is a handicap in the interstate movement of cheese inasmuch as federal requirements specify the terms "whole milk," "part skimmed milk" and "skim milk" as the proper terms to indicate the relative percentage of fat in the several varieties. All cheese must be labeled at the factory and must bear the factory number.

Permits have been issued for the manufacture of at least thirty-eight special varieties of cheese and applications for the manufacture of still others are under consideration. In connection with the issuance of special permits, it must be determined whether the cheese is manufactured by a process in accord with the variety desired, and if the finished product is characteristic of the type indicated by its name. It must also be determined whether the general run of composition and proposed label is correct in each detail and does not carry any deceptive or misleading words or statements.

A campaign for the control of composition of all varieties of cheese is now in progress along the same lines as that which has been so successful in controlling the composition and quality of butter. Under the influence of this enforcement policy and due to the discontinuance of the market formerly provided by the saloon, the amount of inferior cheese manufactured is rapidly decreasing and such growth as is being made is on a sound, permanent basis. Conditions in our mountain counties are the very finest for the production of milk for cheese manufacture and our cities, within our own borders, provide a market for more than four times as much cheese as is now produced in the state. The explosive development of cottage cheese business, increasing as it has from 1,000,000 to 10,000,000 lbs. in about two and a half years has been one of the most spectacular events in the history of the dairy industry of the state. This has resulted from the application of scientific methods to the manufacture of a variety of cheese which was formerly little recognized as being of importance either from a dietary or industrial point of view. Creamed cottage cheese provides one of the most delicious bases for salads and other dishes. Fat-free cottage cheese provides a most satisfactory source of protein food for those who desire a diet low in fats.

The great importance which cottage cheese has recently assumed has resulted in a demand from the larger manufacturers for some protection against the manufacture and sale of inferior substances with no discriminating marks or labels. It will probably be necessary, therefore, to establish definitions for cottage cheese and prescribe a maximum moisture content for plain and creamed cottage cheese and a minimum fat content for creamed cottage cheese. Our program in cheese work for the coming year calls for educating the cheese manufacturers in the use of direct microscopic count for determining the quality of milk received at their plants. The cheese specialist provides special information and help of a regulatory character to those who apply.

V. Ice Cream and Evaporated Milk.

These important products are grouped together because it is convenient for one technical expert to deal with both and because of the large percentage of evaporated milk, especially evaporated skim, which is utilized in the manufacture of ice cream.

Ice Cream.

Ice cream is rapidly gaining in importance as a dairy product in the State of California. In spite of the very large increase in the total production of milk fat in the state during the last five years the percentage of the total relative amount of milk fat utilized in the manufacture of ice cream has increased from 3 per cent in 1920 to 5 per cent in 1925 or in actual amounts from 3,202,000 pounds in 1920 to 5,671,000 pounds in 1925. The total amount of ice cream manufactured has not only increased but there has been a steady advance in the average per capita consumption indicating great appreciation and more satisfaction on the part of the consuming public. In 1920 the per capita consumption of ice cream for the state amounted to about 1.9 gallons whereas in 1925 there were 2.4 gallons per person consumed, or an increase in the per capita consumption for the State of approximately 25 per cent during this period.

The composition of ice cream is carefully guarded by the Bureau of Dairy Control. Samples are collected at intervals from all manufacturers and if the product is found to be below standard necessary action is taken in order to compel observance of the law. It should be stated, however, that ice cream is more consistently up to standard than any other manufactured product of milk and it has rarely been necessary to prosecute.

The question of quality in ice cream, however, demands increased attention. While the ingredients which enter into its manufacture are steadily getting better, speaking generally there are localized conditions which have resulted in attempts to use inferior and cheaper materials and to use increased proportions of the cheaper ingredients to the very great detriment of the finished product. This has resulted in numerous complaints from certain communities where the practice has been followed indicating considerable dissatisfaction among consumers and has given some grounds for agitation to revise the definition and standards for ice cream to the end that the percentage of solids-not-fat be definitely specified as well as a minimum weight per gallon. This latter has not been undertaken because of the difficulty experienced by manufacturers in controlling the uniformity of over-run. It is believed, however, that if prosecutions for incorporating excessive amounts of air be restricted to evidence based upon the average of as many as 100 weighings of the product no injustice can result, and the best interests of the consuming public and the legitimate manufacturer will be protected.

Special permits renewable annually are required for the use of butter in the manufacture of ice cream. This is necessary because the demand for ice cream is periodic. In spasmodic spells of exceedingly hot weather it is practically impossible to secure satisfactory quantities of sweet cream to manufacture ice cream in sufficient quantities to meet the demand. Under these conditions special good butter can be used and just as good ice cream made from it as from sweet cream. It is presumed, however, that the butter used in the manufacture of ice cream shall have been made from cream of sufficient quality to have entered into the manufacture of ice cream had the sweet cream been used direct. It is on this basis that permits are issued and instructions given manufacturers.

During the past two years the revision of the definition for ice cream by the secretary of agriculture under the provisions of the national food and drug act has been under consideration. Considerable effort has been put forth by this bureau to the end that a national standard which is fair and agreeable to all may be adopted. It is our purpose in so far as possible to bring state and local requirements into uniformity with national standards and it is therefore important to us that national standards be such that we can consistently follow them.

Evaporated and Condensed Milk.

The manufacture of evaporated and condensed whole milk has steadily advanced since the slump in production in 1921 and during the last four years has jumped from 67,000,000 to 128,000,000 pounds annually, showing an increase of more than 90 per cent over 1921 and of approximately 50 per cent over 1920. It is now consuming practically 8 per cent of the entire production of milk fat in the state and indications are that its manufacture will continue to increase in the immediate future. This product enters so extensively into interstate trade that local standards have been made to coincide exactly with the national interstate standards and it is only occasionally that we are called upon to take action because of any deficiency in composition. This occurred most conspicuously only in jobbers' plants which are manufacturing for local trade. The great interest which our Bureau has in the manufacture of evaporated milk as respecting the quality of raw materials is discussed under project II pertaining to manufacturing milk and cream. We find that manufacturers of these products universally appreciate this work on the part of the Bureau and have extended us their whole-hearted cooperation.

VI. Imitations.

Enforcement of the General Dairy Law respecting imitation cheese, imitation milk and oleomargarine (imitation butter) is one of the most important activities of the bureau, requiring a very large amount of clerical work and no inconsiderable amount of field investigation. Regulations respecting these products apply mainly to licensing, labeling, advertising and composition. Oleomargarine licenses for the fiscal year ending June 30, 1925, were issued (to those who are required to hold them) as follows:

Manufacturer	6
Wholesaler	56
Retailer	10,827
Bakery or restaurant keeper	1,499
Total	12,378

The dairy law seeks to prohibit the use of dairy terms in advertising these imitation products. However, under present conditions the law is not sufficient to altogether prohibit this deceptive practice and measures are now pending a vote of the people in the coming elections which, if written into the law, will adequately meet the situation. Records indicate that 20,621,545 pounds of oleomargarine were manufactured in California during the fiscal year ending June 30, 1925.

VII. Sampling, Weighing and Testing.

Supervision of sampling, weighing and testing to determine the amount of fat farmers deliver in their cream constitutes one of the largest and most important projects of the bureau. Testers are required to be licensed and all persons sampling and weighing milk and cream who do not hold testers' licenses are required to hold samplers' and weighers' licenses. A person who desires to test may file application with the Department of Agriculture, whereupon he is provided with a set of Questions and Answers which enable him to inform himself concerning the technical information necessary for conducting an intelligent test. He must also practice testing until he becomes adept, whereupon he is given an examination. This examination consists of a written test of his technical knowledge and a demonstration of his ability to apply the knowledge in the test room or laboratory. The inspectors' report of the oral examination and the applicant's answers to the written examination are forwarded to Sacramento where a senior inspector examines all papers and passes upon the issuance of the license. In this way new licenses have been restricted to persons who are competent.

Licenses expire annually in order that those who obtained them before requirements were as rigid as at the present time, and that all persons who have not been actively engaged in testing during the past two years and whose work has not been checked by our representatives during such period, may be reexamined. Having been issued a license, the tester's work is checked at irregular but frequent intervals by selecting at random a number of samples from the total lot required to be held by the tester for the forty-eight hour period after his initial tests are completed and the results recorded and deposited in a sealed test record sheet box. These samples are so selected as to include patrons of the creamery who may be under obligation to sell their product to that plant, patrons of different nationalities, some who are dividing their cream between different plants and others who are selling their product exclusively to the plant where the tester under check is employed. The tester is required to repeat his tests in the presence of an inspector and to observe all details of requirements of Regulation XI of the Dairy Law pertaining to this work, then the inspector and tester read the results of these retests together. After these tests have all been carefully read the sealed test box is opened by the inspector and comparison is made with the tester's previous work.

If these results correspond within a half per cent and there is no general tendency to read either high or low the work is considered accurate. If not, it is necessary that steps be taken to require the tester to conduct his work in such manner that the results will be accurate when the inspector is absent, and if this can not be done the license is withdrawn. Results of the check testing where differences occur are regularly rechecked by the official laboratory in Sacramento and every assistance is given the licensed tester to enable him to maintain his work at a high degree of proficiency.

Records and official test record sheet boxes are supplied at cost by the Department under the provisions of the General Dairy Law pertaining to testing, or specifications are furnished whereby plants may secure these test record sheet boxes for themselves. The quality of the paper and the necessary provision for information must be approved in writing by the Department of Agriculture in case standard official forms are not used.

In the case of samplers' and weighers' licenses somewhat the same procedure is followed but no written examination is given. An oral examination, a demonstration of ability to take samples from several sizes of containers holding various amounts of the product and having different tests, and some oral questions to indicate their familiarity with the things essential for them to know in order to properly weigh and sample either milk or cream are required. The inspector in charge of the district in which the applicant is located passes finally upon the results of the examination, and upon his recommendation the license to sample or weigh is issued or withheld.

As a result of this activity the weighing, sampling and testing of milk and cream throughout California dairy districts is highly efficient as evidenced by the records of this office. Plants may reasonably expect that men who hold testers' licenses are competent to test and able to secure accurate results. Farmers may generally rely upon the accuracy of the test on the basis of which payment for their product is made. If any question arises, however, it should be reported immediately to the Bureau of Dairy Control, Department of Agriculture, whereupon prompt investigation will be made.

Considerable difficulty in securing a uniform, satisfactory sample bottle, especially for cream, has been experienced and it is now contemplated that in the near future the Department will be able to issue specifications for the manufacture of cream sample bottles and manufacturers who produce a bottle embodying these specifications will be permitted to emboss in appropriate wording on the glass of the bottle the approval of the department.

VIII. Statistics.

Statistics relative to production, manufacture and value in state movements, and of values and per capita consumption and per cow production of dairy products, are very necessary to the intelligent conduct of business by commercial concerns engaged in the manufacture and distribution of dairy products and are a reliable index to those interested in promoting the development of a properly balanced agricultural program in the State of California. More complete statistics for dairy products are available than for any other product in the state and few states have as complete dairy statistics as now available in California.

The last Legislature changed the date for the annual compilation of statistics from the fiscal year ending June 30 to the calendar year ending December 31. Therefore statistics for the last six months of 1924 and the calendar year 1925 are now in the course of preparation and will be issued as a special publication as in previous years.

The regular features which have previously been published in this report are as follows:

1. Amount and value.
2. Milkfat by counties (estimate of production).
3. Market milk distributed by counties.
4. Butter manufactured by counties.
5. Cheese manufactured by counties.
6. Cheese manufactured by varieties.
7. Ice cream by counties.
8. Production and manufacture of the several products over ten year period.
9. Annual receipts in San Francisco for ten year period.
10. Monthly receipts in San Francisco for three year period.
11. Monthly conditions in San Francisco for the year.
12. Average price butter and cheese over ten year period.
13. Number plants reporting all of each product produced, manufactured or distributed.

New features which have been added to the report this year are:

1. Receipts of butter and cheese in California—other points than San Francisco.
2. Interstate movements of products.
3. Cold storage movement of products.
4. Per capita consumption of market milk, ice cream, butter, cheese and evaporated milk in 1925, and market milk and ice cream for five year period.
5. Average production per cow for state.
6. Table of utilization indicating per cent of total milk fat which was utilized in the several products of milk.
7. Addition of ice cream to the tabulated production of manufactured products for ten year period.

A summary of the statistical report for the present calendar year and number of plants reporting for the several products is as follows:

Number of reports received	*Article*	*Amount*		*Approximate value*
149	Butter	73,599,867	pounds	$36,166,876
92	Cheese (total all types exclusive of cottage and full skim cheese)	7,408,313	pounds	1,781,188
47	Cottage cheese	10,051,863	pounds	1,507,780
2	Full skim cheese	403,114	pounds	80,623
11	Evaporated whole milk	15,981,303	pounds	10,583,294
9	Evaporated skim milk	6,640,209	pounds	
7	Sweetened condensed whole milk	12,712,968	pounds	1,206,460
5	Sweetened condensed skim milk	3,656,516	pounds	100,189
3	Powdered whole milk	767,617	pounds	203,419
9	Powdered skim milk	17,900,855	pounds	1,306,762
	Milk sugar (crude and refined)	1,447,344	pounds	217,102
15	Albumen, curds, lactein, semi-solid buttermilk	28,975,639	pounds	1,448,782
13	Dried casein	5,570,158	pounds	578,739
311	Market milk—raw	23,248,032	gallons	
	past.	78,457,486	gallons	
	Market milk (total)	101,705,518	gallons	45,258,956
	Market cream—raw	147,704	gallons	258,482
245	Market cream—past	5,617,821	gallons	9,269,405
333	Ice cream (including nut and fruit)	11,455,939	gallons	15,121,840
21	Ice milk	149,873	gallons	119,898
59	Skim milk (for human consumption)	1,005,652	gallons	231,300
79	Buttermilk (for human consumption)	2,048,212	gallons	512,053
51	Cultured skim milk	1,891,225	gallons	472,806
11	Chocolate milk	97,842	gallons	54,792
1472	Total milk fat	125,043,036	pounds	$126,480,746

Plans for the improvement of dairy statistics in the future are contemplated in cooperation with the Bureau of Agricultural Economics, U. S. Department of Agriculture, in such a way that the amounts of the several products manufactured or produced may be reported by months as the season advances. It is also to be hoped that all commercial concerns, trade associations and chambers of commerce or any other such body, will indicate their desires concerning statistics in order that the state and federal departments may gather all of the information in one effort which will be able to supply all the needs, thus eliminating the great waste of effort in securing these details independently and even then incompletely and more or less inaccurately, and the necessity for rendering so many statistical reports by the several receivers, manufacturers and distributors.

IX. Federal State Cooperative Commercial Scoring.

By means of a cooperative agreement between the Bureau of Agricultural Economics, U. S. Department of Agriculture, and the State Department of Agriculture, and by means of a cooperative agreement between the San Francisco Mercantile Exchange and the State Department of Agriculture and between the shippers of eggs at Petaluma and the State Department of Agriculture, provision has been made for starting inspection and scoring of butter, cheese and eggs in San Francisco and Petaluma on the basis of the commercial standards for these products adopted by the Bureau of Agricultural Economics of the U. S. Department of Agriculture.

California has lead the field in the standardization of dairy products. Many fruits are also examined chemically as a basis of standardization and attention is now being directed to poultry products, eggs in particular. Eggs have been standardized heretofore by outward appearance. Clean eggs of uniform size and color appeal to the eye, but as it is the inside of the egg which is eaten all quality factors should be considered in determining the relative merits and commercial grade. Five quality factors are considered in classifying eggs under the U. S. standard grades. These are:

1. Condition of shell indicating the cleanliness of conditions under which it is produced and handled.
2. Air cell indicating the extent to which moisture has been evaporated from the contents and therefore the freshness.
3. Color and firmness of the yolk.
4. Clearness and firmness of the white.
5. Visibility of the germ.

As matters now stand it remains for the producer and dealer in eggs to class them for inspection on the basis of these factors. Until this is done any lot of eggs cannot be satisfactorily classified and the highest value cannot be obtained. The very object of standardization is to secure uniformity and definition with respect to all quality factors. Having attained a satisfactory classification it is considered necessary to educate the grocery trade and the consuming public to the merits of the several classes in order that they may use them in making purchases, thereby accomplishing the purpose intended. This purpose is greater satisfaction on the part of the consumer, with freer markets and better prices to the producer and special recognition in the matter of price for those who take the pains to produce superior products. The present designations applied to eggs are U. S. "A," "special," "extra," "standard" and "trade." These terms are somewhat vague and indefinite in their meanings making it the more necessary to educate the public relative to their significance.

All butter, cheese and eggs which are sold on the San Francisco Mercantile Exchange are inspected and graded by federal-state inspectors, thus insuring a market based on products of the exact quality represented. Inspections on butter, cheese, or eggs are likewise available to the trade as a means of adjusting disputes or as certification of quality for shipment. All certificates of inspection are accepted as evidence of quality of these products at the time of inspection in all courts of the United States. There are at the present time one general supervising inspector, one federal-state butter inspector, one federal-state supervising egg inspector, two federal-state egg inspectors. The general supervising inspector devotes only part of his time to this work, the larger portion being devoted to the market news work of the Bureau of Agricultural Economics. Likewise the butter inspector devotes but part of his time to this work, the larger portion being occupied with his duties as butter specialist in the Bureau of Dairy Control of the State Department of Agriculture. All others are full time employees receiving most or all of their salaries from the funds received through inspection fees and guaranteed under the cooperative agreements between the State Department of Agriculture and the butter and egg trade. Much credit is due the representatives of the Bureau of Agricultural Economics who have been active in the organization of this work in San Francisco and it is to be expected that the service will spread by reason of demonstrated merit to other sections of the state.

The Bureau of Dairy Control likewise gathers daily information concerning receipts of butter, cheese and poultry products on the Los Angeles markets which is reported by the market news service of the Bureau of Agricultural Economics.

X. Legal Procedure.

All of the foregoing activities require a certain amount of time devoted to legal procedure in connection with their enforcement. This, however, is of such special character and is so essentially the same for whatever project may be concerned or whatever provision of law may be violated that it is classified as a separate project, and there should be available the full or part time services of an attorney to give attention to these matters.

Several hearings concerning violations are held each month before the chief of the bureau or other authorized representative of the director. These hearings may be to show cause why licenses should not be revoked, prosecution made or why impounded products should not be condemned. Legal procedure in connection with suspensions, revocation of licenses, prosecutions, preparation of evidence, issuance of legal rules, official forms, etc., are primarily directed by the chief of the bureau but require a great deal of time and in some instances travel. Budgets, claims, bills, trust fund agreements and other matters of this character are likewise classified under this project.

Summary.

In reviewing the work of the bureau since it was organized the following activities and accomplishments stand out conspicuously as improvements over conditions which formerly existed:

The rapid extension of the graded milk program provided for by the Pure Milk Law; improvement in quality of market milk under the influence of regular surprise scoring contests; milk served by restaurants in individual containers; increased attention to the sterilization of dairy products containers; improvement in accuracy and working condition of recording thermometers; use of the direct microscopic count in appraising the quality of milk for manufacturing purposes; elimination of turnips as a dairy feed and the resulting menace of tainted butter; posting dairy farms with concise statements of necessary requirements of law and giving the essential reasons therefor; the revision of the dairy farm score card giving emphasis to the various items more nearly in proportion to their importance; standardization of butter to uniform composition; improvement in quality, composition and labeling of established varieties of cheese and the issuance of permits for special varieties; use of power of summons for hearings, license revocation and the suspension of dairies in the enforcement of necessary measures; adoption of a systematic record system in connection with all activities; and the general cooperative spirit which has been developed within the industry and between the industry and our regulatory work. Among the foregoing those activities which represent the most conspicuous developments of the past year are the use of the direct microscopic count in grading manufacturing milk, the more definite classification of the special varieties of cheese manufactured in California and issuance of permits in connection therewith, and the general improvement in quality of all varieties of cheese manufactured in the state.

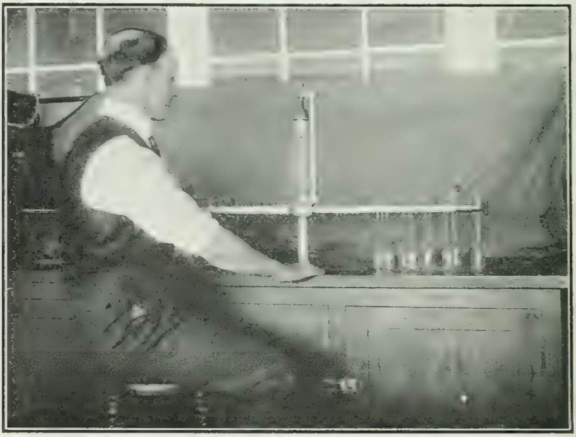


FIG. 14. Calibration of Babcock milk and cream test bottles in the Dairy Laboratory, Sacramento.

DIVISION OF CHEMISTRY.

GEO. P. GRAY, Chief.

Functions of Division.

The clearly defined functions of the Division of Chemistry are to be responsible for all the chemistry work required by the department and to carry out the instructions of the Director of Agriculture in the administration of those laws, the major part of which consist of the examination and analysis of products offered for sale.

Concretely stated the activities of the division are as follows:

1. Administration of the Fertilizer Law:
   a. Registering and licensing manufacturers and dealers.
   b. Collection of tonnage taxes.
   c. Sampling and analyzing all brands of commercial fertilizers offered for sale and publishing the results.
   d. Prosecuting those who sell commercial fertilizer without license or payment of tonnage taxes.
   e. Prosecuting those who sell commercial fertilizer without proper labels, which is below the guaranteed analysis, and those who sell animal manures with artificially added sand or water.

2. Administration of the Agricultural Minerals Law:
   a. Registering and licensing manufacturers and dealers.
   b. Collection of tonnage taxes.
   c. Sampling and analyzing all brands of agricultural minerals offered for sale and publishing the results.
   d. Prosecuting those who sell agricultural minerals without license or payment of tonnage taxes.
   e. Prosecuting those who sell agricultural minerals without proper labels, and which are below guaranteed analysis.

3. Administration of the Economic Poison Law:
   a. Registration and licensing manufacturers and dealers.
   b. Sampling and analyzing substances offered for sale in the state to be used for the control of insects, fungi, weeds and rodents, and publishing the results.
   c. Prosecuting those who sell adulterated or misbranded economic poisons.

4. Operation of the Dairy Laboratory:
   a. Chemical and bacteriological examination of dairy products as required by the Bureau of Dairy Control and furnishing expert testimony in court cases.
   b. Testing and certification of all instruments used by creameries to determine the percentage of butter fat in milk and cream.

5. Analysis of miscellaneous substances required by other divisions of the department.

6. Testing of instruments and supplying standard solutions for all county horticultural commissioners making the 8 to 1 test to determine the ripeness of oranges, and instructing these officials

and their deputies and inspectors in the technique of making the test.

7. Public service:
   a. The analysis of economic poisons, fertilizers, and allied substances such as agricultural lime. gypsum and so-called soil stimulants for public officials and individuals.
   b. Analysis of milk and cream for individuals.
   c. Correspondence, personal visits and conferences pertaining to the activities outlined.
8. Investigations:
   a. Chemical and bacteriological investigations to improve the quality of dairy products and to prevent and detect spoilage.
   b. Chemical investigations to obtain information when needed for the intelligent enforcement of the various laws administered by the department.

Organization of Work.

Five chemists are employed in the General Laboratory for the analysis of fertilizers. agricultural minerals. economic poisons, and for the miscellaneous work of the division. One chemist was added to the force of the Dairy Laboratory, making a total of three chemists and one bacteriologist engaged in the examination of dairy products in cooperation with the Bureau of Dairy Control. One inspector was added to the force during the year so that at the present time there are engaged in the inspection work in the administration of the fertilizer. agricultural minerals and economic poison laws. one chief inspector and five inspectors. All of the inspectors are engaged in the enforcement of the three laws mentioned above. which makes for economy and efficiency of operation.

Fertilizer Law.

A detailed report of the administration of the fertilizer law for the calendar year 1925. prepared by Mr. Firman Thompson. chemist in charge of the General Laboratory, has been prepared as a special publication of the department. This report will show that there are in force seventy-five fertilizer licenses. During the year 376 samples of fertilizers were collected. analyzed and reported upon in this publication.

This report will show that the consumption of fertilizers and agricultural minerals has materially increased during the year 1925. It is thought that this increased use of fertilizer is an indication of agricultural prosperity. This increase. however. is due to some extent to a large tonnage of fertilizer sold in the Imperial Valley, which heretofore has not made any large use of it in the growing of truck crops. The following tabulation shows the tonnage of fertilizers consumed in the state for the past twenty-three years by quarters:

TONNAGE REPORTS.

Showing Tons of Fertilizer Sold in the State from 1903 to 1924 by Quarters.

Quarter ended	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
March 31	....	5,150	5,442	8,103	9,522	14,241	19,075	21,159	23,017	24,615
June 30	....	1,784	2,402	4,048	5,618	6,234	7,718	8,154	9,998	9,327
September 30	1,504	772	1,636	4,161	4,772	5,309	4,850	8,213	11,023	8,329
December 31	1,454	1,367	3,013	3,333	6,009	5,640	7,060	7,397	7,403	7,955
Totals	2,958	9,073	12,493	19,645	25,921	31,424	38,703	44,923	51,441	50,226

Quarter ended	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
March 31	12,846	17,328	15,483	16,044	23,575	15,043	20,327	27,351	31,892	33,033
June 30	6,921	8,135	7,076	7,010	8,626	8,146	8,104	11,791	12,715	20,215
September 30	5,391	4,416	3,057	5,888	3,389	6,717	8,726	10,767	11,563	8,644
December 31	6,233	4,521	3,288	5,765	5,452	8,114	13,002	16,471	16,459	12,994
Totals	31,391	34,400	28,904	34,707	41,042	38,020	50,159	66,380	72,629	74,819

Quarter ended	1923	1924	1925
March 31	37,838	30,205	43,482
June 30	11,888	12,795	13,640
September 30	8,382	8,656	9,630
December 31	13,711	14,618	....
Totals	71,819	66,274	66,752

It is interesting to note that the amount of fertilizer consumed in California for the period January, February and March, 1925, was the greatest used in any quarter since these reports have been compiled.

Few prosecutions have been required for the successful administration of the fertilizer law for the reason that the cooperation of the fertilizer industry has been secured. In one instance, however, it was found necessary to file complaint for selling a lot of some 250 tons of unlabeled potash of inferior quality. A number of cases were successfully prosecuted in Orange County, involving the shipment of animal manures which had been adulterated by the addition of sand and water.

The chief of the Division of Chemistry has been made an honorary member of the California Fertilizer Association and has attended all of its meetings, thus keeping in close touch with the advance thought of the fertilizer industry of California. It is particularly gratifying to note that by the activity of the association a most determined effort is being made to place the fertilizer industry on a higher plane of business ethics, and that a movement has been inaugurated to very materially decrease the number of brands being sold and, if possible, to agree upon a reasonable uniformity of recommendations for the use of fertilizers in the different sections of the state and for particular crops, in so far as these recommendations can be based upon adequate data.

Agricultural Minerals Law.

The administration of this law has been carried on in conjunction with the fertilizer law and a detailed report of activity in this work has been included in Mr. Thompson's report on the administration of the fertilizer law mentioned above. The records of the division show that forty agricultural minerals licenses were in force at the time of the publication of the report. The following tabulation of the tonnage reports indicates the movement of agricultural minerals for the different seasons and shows the total reported since the law became operative:

		Calendar year	
Quarter ended	*1923*	*1924*	*1925*
March 31		11,943	11,411
June 30		6,584	7,276
September 30		7,337	9,886
December 31	10,903	18,379	22,161
Total	10,903	44,243	50,734

Economic Poison Act.

A detailed report of the administration of the California Economic Poison Act of 1921 for the fiscal year ended June 30, 1925, has been published as Special Publication No. 58 of this department. The records of the office show that the following number of licenses were issued for the fiscal year ended June 30, 1925:

Paid licenses	266
Exempt licenses:	
County officials selling at cost	34
Manufacturers of household remedies manufacturing less than $500 worth per annum	64
Total	364

In this publication there are reported analyses of 465 samples as follows:

	Samples tested	*Samples below guarantee*
Arsenicals	81	25
Copper compounds	45	14
Sulphur and sulphur compounds	149	28
Nicotine preparations	20	8
Rodenticides	67	23
Emulsions, miscible oils and soaps	60	10
Cyanogen compounds	43	8
Total	465	116

This bulletin was published within ninety days after the expiration of the quarter so that information was available to prospective purchasers concerning the performance of the companies selling economic poisons in the state. This bulletin has grown in importance in the last two years to such an extent that the larger consumers of economic poisons in the state refer to it to ascertain the standing of the companies before purchasing their supplies. This makes a special incentive for the manufacturers of economic poisons to maintain a high standard of perfection. A mailing list is being compiled of economic poison consumers and dealers in the state and a copy of this bulletin is mailed to each one of these.

Cancellation of Licenses.

The right of the Director of Agriculture to refuse to register, or cancel the registration of a firm which is attempting to sell fraudulent or worthless insecticides to the fruit growers of this state, has been upheld in a recent decision in the Appellate Court in the case of *A. R. Gregory* vs. *G. H. Hecke as the Director of the Department of Agriculture.* Gregory was manufacturing and selling an insecticide under the name of "Qua-Sul" and claimed that it was the "most efficacious remedy known; and an absolute remedy for, and the greatest germicide known to destroy mildew, aphids, codling moth, fungoid diseases, eggs and larvae of insects and pests."

The director caused an investigation to be made and it was found that "Qua-Sul" was of little or no value. The department exercised the power given it through the Economic Poison Law and instituted proceedings to revoke the license previously granted to Gregory to sell materials of this kind. Gregory, however, appealed to the courts on the ground that the law was unconstitutional. The Superior Court sustained his contention, but the department appealed to the Appellate court, and under a decision written by Judge Thomas Rolfe and concurred in by Justices P. I. Finch and J. Plummer, the court stated in part as follows:

"Clearly the legislature intended by this act to not only regulate the manufacture and sale of economic poison, but it intended also to protect the large and valuable orchard and horticultural interests of California against fraud, imposition and misrepresentation as to the efficiency of antidotes for germ and fungoid diseases.

"It is for alleged violation of the reasonable regulations and restrictions provided, not by the Director of Agriculture, but by the legislature, that respondent was cited to show cause why his license should not be revoked.

"The regulation of the use and sale of economic poisons for the evident purpose intended in this Statute of 1921, is akin to and probably more important than the statutes regulating fertilizers. One of the most common instances of the exercising of police powers in reference to agriculture is the regulation of the sale of commercial fertilizers. The controlling purpose of such statutes is to guard the agricultural public against the spurious and worthless compounds sometimes sold as fertilizers and to fix on sellers a statutory guarantee that fertilizers sold by them shall contain the chemical ingredient guaranteed by them, thus furnishing to purchasers a reliable means of proving any deception thus attempted. As these statutes prevent fraud and promote the agricultural industry, they are strictly in the scope of legitimate regulations."

Upon complaint of a horticultural commissioner and certain growers of Orange County a hearing was held to determine whether or not the license for the sale of a certain spray manufacturer should be canceled on the ground that the spray was seriously injurious to the fruit of orange trees to which it had been applied. The evidence presented at this hearing showed beyond any reasonable doubt that the spray had caused serious spotting of the fruit to such a degree as to seriously lower its grade at the packing house. The license authorizing the sale of this material in the state was therefore canceled.

The same result was accomplished in two or three other cases, but without the necessity of a formal hearing. In one case evidence was presented to the department showing that the application of a certain sticky tree banding substance was seriously injurious to prune trees when applied to the trunks. Upon reviewing the evidence in this case the company voluntarily withdrew its registration of the product causing the damage. A similar result was accomplished following a test of nicotine capsules to be used for the control of poultry round worms. The laboratory test indicated that these capsules were a potential source of danger to poultry on account of the fact that the nicotine had not been sufficiently absorbed by the carrier. Upon informing the company of our findings registration of these capsules was withdrawn without the necessity of a formal hearing.

Through correspondence and personal conferences many labels have been revised so as to make more truthful claims concerning the efficacy of the product to which they are attached. In several instances the department has expressed its doubt as to the efficacy of certain economic poisons, or certain strengths, based upon general experience. In a number of cases the manufacturers have voluntarily removed from their labels certain recommendations which were of doubtful nature.

Efficacy Tests.

Arrangements have been made to cooperate with the Bureau of Plant Quarantine and Pest Control to test the efficacy of insecticides and fungicides for which it appears extravagant claims have been made. The data obtained in experiments to be conducted under this cooperative agreement will be used for two purposes: First. evidence to be used in filing complaint on a misdemeanor charge for selling economic poisons with misleading statements; second, for the cancellation or refusal of licenses for materials seriously injurious to vegetation, to domestic animals. or to the public health. or which are of little or no value.

DAIRY LABORATORY.*

Laboratory and Equipment.

The dairy laboratory is operated by the division of chemistry for the purpose of making such chemical and bacteriological examinations of dairy products and substitutes as are required for the enforcement of the dairy laws of the state and for assisting producers and manufacturers in complying with these laws.

The work has been conducted along the same lines and in the same manner as during the previous year. In addition to the person in charge, there has been employed throughout the year a force of two chemists, a bacteriologist, two laboratory assistants and a stenographer. One other chemist has been employed for about half the year.

---

* By C. F. Hoyt, in Charge.

The work may be tabulated under the following heads:

1. Examination of dairy products for the maintenance of legal standards.
2. Examination of samples from a sanitary standpoint.
3. Examination of milk and cream samples for checking the accuracy of factory testing.
4. Examination of samples from individuals—usually as a means of adjusting controversies.
5. Examination of testing apparatus for accuracy and for compliance with legal specifications.
6. General work.

Examination of Samples for Maintenance of Legal Standards.

There are legal standards and definitions for the following named articles:

1. Milk.
2. Goat's milk.
3. Sheep's milk.
4. Cream.
5. Evaporated milk.
6. Evaporated cream.
7. Evaporated skim milk.
8. Evaporated goat's milk.
9. Butter.
10. Cheese (several types).
11. Ice cream.
12. Fruit ice cream.
13. Nut ice cream.
14. Ice milk.
15. Milk fat.
16. Skim milk.
17. Buttermilk.
18. Milk drinks.
19. Treated milk.
20. Imitation milk.
21. Oleomargarine.

Samples of some of these products have been submitted by inspectors of the Bureau of Dairy Control. Table 1 shows the number examined and the results.

TABLE 1.

	Above Standard	*Below Standard*	*Total*
Milk	154	13	167
Cream	128	--	128
Butter	295	96	391
Cheese	166	161	327
Ice cream	291	63	354
Ice milk	1	--	1
Evaporated milk	9	8	17
Totals	1044	341	1385

Examination of Samples for Sanitary Condition.

Some samples have been examined for their condition from a sanitary or bacteriological standpoint. Table 2 shows the number so examined.

TABLE 2.

Milk	823
Cream	6
Butter	5
Evaporated milk	5
Water	13
Miscellaneous	1
Total	853

Examination of Samples for Checking Accuracy of Factory Testing.

In order to insure dairymen honest and accurate tests of butterfat delivered in the form of milk or cream to factories of dairy products, these factories are required by law to retain all samples for 48 hours after testing. Inspectors of the Bureau of Dairy Control send some of these samples to the laboratory from each of the various factories in the state. Judgment of the character of work done by individual testers may be based on a comparison of the results obtained by the tester and by the laboratory. Table 3 shows the number of these samples tested.

TABLE 3.

Milk	150
Cream	1254
Total	1404

Examination of Samples from Individuals.

Table 4 shows the number of samples that have been examined for individuals.

TABLE 4.

Milk	480
Cream	70
Butter	9
Ice cream	12
Cheese	1
Skim milk	13
Miscellaneous	4
Total	589

Examination of Testing Apparatus.

It has been the law in this state for a long time that glassware and other apparatus used by factories for determining the fat content of dairy products must be examined by this department for accuracy and for compliance with legal specifications. In addition to this apparatus, examination of which is required, apparatus of other kinds used by inspectors and by factories has been examined. Also ground glass slides have been prepared for the use of inspectors. Table 5 shows the results of this work.

TABLE 5.

	Approved	*Not approved*	*Total*
Babcock test bottles	17,994	165	18,159
Babcock pipettes	1,840	1,469	3,309
Pipettes, 1 ml.	257	13	270
Pipettes, 0.01 ml.	---	---	15
Lactometers	---	---	5
Weights	---	---	32
Weights (sets)	---	---	5
Microscopes	---	---	3
Measuring devices	---	---	4
Ground glass slides for direct count	---	---	450
Thermometers	---	---	32
Totals	20,091	1,647	22,274

General Work.

Considerable work has been necessary in order to provide an adequate foundation for interpretation of results on particular samples, for general rulings on various matters and for procedures required for the intelligent execution of the dairy laws. Some of the more important items of this work may be mentioned here.

In order to learn the suitability of different methods of analysis for various substances, and to learn the limits of their accuracy, numerous comparisons of results obtained by these different methods have been made. Among these may be mentioned methods for determining citrates in cheese and chlorine compounds in milk.

In order to learn the limits of accuracy to be expected in the analysis of cheese, collaborative work has been carried on with the branch of the University of California at Davis.

In view of the proposed introduction into the state of the European method of testing dairy products known as the Gerber or Fucoma test, considerable study of this method has been made, results obtained by it being compared with results by the Babcock and Roese-Gottlieb (Majonnier) methods.

Assembling of information and data as an aid in distinguishing foreign fats in dairy products such as butter, cheese and ice cream has been prosecuted as opportunity has offered throughout the year. This has been done by the trial of methods newly come upon and the determination of characteristic constants of oils and fats of known purity.

A considerable amount of time has been devoted to acquiring information on the methods for examining lactometers for accuracy and the best manner of reading them. This has involved some study of the surface tension of liquids. As a result of this work a recommendation has been made that the manner of reading them prevailing heretofore in the state be changed.

To provide a foundation for the establishment of standards for the numerous less common varieties of cheese manufactured in the state, several samples of representative makes of each of these varieties have been collected by inspectors and analyses of them have been made.

In furtherance of a study of the losses of butterfat in buttermilk and skim milk sustained by creameries in the manufacture of butter and of a study of the overrun to be expected, samples of skim milk, buttermilk, wash water and butter collected from factories in different parts of the state have been analyzed.

In order to secure information on which action may be based with respect to the enforcement of the law on sterilization of dairy utensils considerable time has been given to the study of a chlorine disinfectant. This work is still in progress.

Some study of the possibility of using the direct count method for determining the quality of cream for butter making purposes has been made. This work also is still in progress.

As an aid to inspectors in the field using the direct count method for estimating bacteria a considerable number of pure cultures of various kinds of bacteria have been accumulated. As already mentioned, a method of marking specified areas on microscope slides by means of a sand blast has been devised and slides so marked have been supplied several inspectors. Also a bath for staining these slides has been devised.

Preliminary preparations have been made for making determinations of the phenol coefficient of disinfectants. This has involved principally the assembling of the necessary apparatus.

Table 6 shows the number of examinations involved in this work.

TABLE 6.

Article	*Chemical*	*Bacteriological*	*Total*
Milk	114	433	547
Cream	41	144	185
Butter	*60	---	*60
Cheese	37	1	38
Ice Cream	*77	---	*77
Evaporated milk	*16	---	*16
Milk, skim	5	---	5
Buttermilk	76	---	76
Wash water	60	---	60
Rinse water	---	59	59
Milk bottles	---	368	368
Milk and cream cans	---	18	18
Dairy equipment	---	6	6
Miscellaneous	3	35	38
Total	489	1064	1553

* Included also in table 1.

Considerable time has been used in familiarizing new inspectors with the methods to be used in taking and sending samples to the laboratory, with methods of examination used here and with methods to be used in the field. Some time has been used in examining candidates for licenses for operating the Babcock test. Some time also has been consumed in the preparation of exhibits for fairs or shows. Various standard and other solutions have been prepared for the use of inspectors in the field.

Tables 7 and 8 are summaries of tables 1 to 6 inclusive, showing the total number of examinations of various classes of products made throughout the period.

TABLE 7.

Milk	2167
Cream	1643
Butter	465
Cheese	366
Ice cream	443
Evaporated milk	38
Ice milk	1
Buttermilk	76
Milk bottles	368
Milk and cream cans	18
Dairy equipment	6
Skim milk	18
Water	13
Rinse water	59
Wash water	60
Miscellaneous	43
Total	5784

TABLE 8.

Pieces of Babcock apparatus examined	21,468
Pieces of apparatus other than Babcock examined	358
Microscope slides prepared	450
Total	22,276

DIVISION OF WEIGHTS AND MEASURES.

By CHAS. F. HAYDEN, Assistant Chief.

Following are the various laws over which this division has supervision:

1. Weights and Measures General Law. 2. Public Weighmaster Act. 3. Bread Standardization Act. 4. Net Container Act. 5. Mattress Regulation. 6. Hay Baling Act.

Weights and Measures Law.

The Weights and Measures general law, which is a constitutional provision in the California statutes, provides the division with authority to set standard weights of commodities.

Recently legal opinions forwarded to this department, protesting against certain standards and declaring Section 6 of the Weights and Measures laws unconstitutional, were referred by the Director of Agriculture to the Attorney General for his opinion. The Attorney General ruled that Section 6 was constitutional, and vested the Director of Agriculture with the power to standardize.

The following commodities have been standardized by the Division of Weights and Measures:

Blackberries	12 oz. and 8 oz. baskets.
Bran	60 lbs. net weight per sack.
Butter	¼ lb.. 1 lb. and 2 lb. cubes.
Cement	376 lbs. per barrel or 94 lbs. net weight per sack.
Charcoal (soft)	30 lbs. net weight per sack.
Charcoal (hard)	40 lbs. net weight per sack.
Coal	100 lbs. net weight per sack.
Codfish	1 lb. and 2 lb. squares.
Flour	196 lbs. per barrel and the subdivisions thereof.
Loganberries	12 oz. and 8 oz. baskets.
Milk	8.60 lbs. per gallon.
Olive oil (in tin containers)	1 gal. and the subdivisions thereof.
Onions	100 lbs. minimum net weight per sack.
Potatoes	100 lbs. minimum net weight.
Raspberries	8 oz. baskets.
Rolled barley	75 lbs. net weight per sack.
Shingles (redwood and cedar)	231 standard width shingles, when packed 50 courses to the bundle.
Strawberries	12 oz. baskets.

Olive oil is standardized in tin containers to the U. S. gallon and the subdivisions thereof so as to minimize the number of sizes of containers, thereby reducing the price of this commodity, and also providing the consumer with a clearer understanding of the size of the commodity purchased. In many instances a twenty-eight ounce can will look almost as large to the purchaser as a thirty-two ounce can.

The strawberry container was standardized by an act of the legislature to contain 33.6 cubic inches; the equivalent of this in avoirdupois weight is twelve ounces, which is the standard set by this department.

The standard width of a shingle for the purpose of calculation is fixed at four inches. Five shingles constitute a course, allowing air space in each course not to exceed one and one-half inches.

The Weights and Measures laws also provide for the appointment of Sealers of Weights and Measures, the duties to be performed by them, and the instructions they are to receive regarding the enforcement of these laws by the state department.

Public Weighmaster Act.

The Public Weighmaster Act is a separate act written into the statutes by the legislature in 1915. This act makes provision for the public weighing of commodities, and the issuance of weight certificates.

During the year 1925, this department certified to 214 weighmasters.

We have at the present time bonded with this division 1383 certified public weighmasters, 214 of whom were appointed during 1925.

According to statistics of the California Development Association, there were produced in 1925 approximately 5,000,000,000 pounds of products. From the best information obtainable, it is safe to say that weighmasters weighed approximately 90 per cent of these, or 4,500,000,000 pounds.

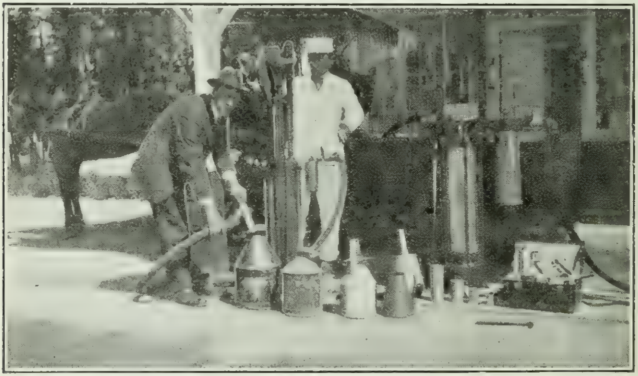


FIG. 15. Testing the accuracy of gasoline pumps has become one of the very important duties of the division.

During the past year we have certified to approximately forty public weighmasters whose activities are devoted to the weighing of crushed rock, gravel, sand, etc. It is only during the past year that builders and contractors have realized the importance of demanding weight certificates in the purchase of supplies.

Net Container Act.

In the enforcement of the Net Container Act we have most of our troubles, for the following reasons:

The Net Container Act was written into the statutes on May 27, 1913, and was later amended in 1915, 1917 and 1919. The purpose of this act originally was to provide for the indicating of the net quantity of foodstuffs and material to be used or prepared for use as food for human beings. This act originally was similar to the U. S. Department of Agriculture's Net Container Act as written into the statutes of practically every state in the union.

Beween the period of 1913 and 1917 there were so many complaints and requests filed with the department regarding the fraudulent sale of commodities in containers (other than food products) that careful study was given the matter and recommendation made to the legislature by representatives of this division that the act be amended to apply to all commodities. The representatives of the Division of Weights and Measures were instrumental in assisting in the promulgation of these amendments. It is reasonable to assume that it is important that the purchaser of oils, paints, gunpowder, nails, lime, sulphur and numerous other commodities receive the same protection as is afforded the purchaser of tea, coffee, sugar, etc.

Bread Standardization Act.

Bread is standardized in one pound and one and one-half pound loaves and the multiples thereof by an act of the legislature. This is due to the fact that section 6 of the Weights and Measures law grants to the Division of Weights and Measures the authority to standardize any commodity, produce or article, excepting any manufactured commodity of four or more staple ingredients. More than four staple ingredients are used in the manufacture of bread, therefore the department has no authority to standardize this commodity.

Mattress Regulation.

In the enforcement of the mattress regulations during the past year we have enlisted the assistance of the Better Business Bureaus of Los Angeles and San Francisco to locally supervise the work, principally for the reason that they are in a position to discourage fraudulent methods of advertising. As a result of this cooperation, the mattress industry today is in a far more healthy condition than at any time in its history.

Hay Baling Act.

During the past year we have had few complaints regarding the erroneous indication of weights on bales of hay, and we feel that the Hay Baling Act is one of the most important on the statutes. It has practically eliminated the fraudulent hay baler, who bales on a basis of so much per ton, and who formerly placed wooden tags in the bales. By a careful plan of education the consumer is now able to protect himself by buying on a weight basis at time of delivery.

APPARATUS INSPECTED, 1925.

Scales.

County	Establishments visited.	Certificates issued	Counter				Spring			
			Corrected	Sealed	Out of order	Condemned and confiscated	Corrected	Sealed	Out of order	Condemned and confiscated
Alameda	11,247	11,247	497	1.076	246	16	595	1.346	261	49
Amador	131	131	1	25	2		1	11	1	
Butte	1,497	1.158	24	49	4		6	36	1	5
Calaveras	139	139	11	59	3		3	20	1	4
Colusa	257	228	5	56	2		3	28	2	
Contra Costa	1,330	1,193	59	198	23	9	23	185	12	14
Del Norte	73	73	16	16			6	6		
El Dorado				16			4	11	9	
Fresno	3,724	3,767	127	157	8		222	400	18	14
Glenn	218	188	3	40	4			18	3	
Humboldt	632	632	60	60			217	217		
Imperial			16	1.121	3	4	9	233	11	1
Inyo	111	112	25	53	1		5	7		
Kern	779		5	18			41		143	3
Kings	783	787	52	100	11	1	3	36	3	5
Lake	163	130	15	57			3	14		5
Lassen	131	131	7	28	1		18	44		4
Los Angeles	22,643	26,760	631	4.459	137	60	6,061	8.711	180	729
Madera	406	406	10	50	3	1	6	43	1	9
Marin	1,092	572	28	175	5	3	31	150	5	13
Mariposa	28	28	1	5			4	8	3	
Mendocino	351	345	11	93		3	8	27	3	4
Merced	748	748	12	71	3		10	42	2	1
Modoc	117	117	2	31				12		
Monterey	816	671	34	71	1	1	19	76	3	
Napa	523	523	17	46	5		12	20	3	5
Nevada	133	133	10	23			6	15		
Orange	993	993	19	73		3	49	192	1	16
Placer	731	555	20	139	3		13	70	4	3
Plumas	216	216	4	33	1		1	10		
Riverside	1,269	980	31	32	1		262	262	3	6
Sacramento	1,099	1.099	20	2,050	62	1	28	422	13	1
San Benito			14	33	4	3	10			19
San Bernardino	1.069		37	221	1		27	184	1	
San Diego	7,670	6.436	305	1,618	86	10	222	1.319	51	20
San Francisco	16.570	10.147	245	3.124	27	6	347	4.291	75	22
San Joaquin	2,744	2,297	52	244	3	2	79	303	32	6
San Luis Obispo	1,261		148	109	47	10	201	131	20	42
San Mateo			4	27			32	181	7	1
Santa Barbara	1,803	1.076	54	283	1		49	88	1	
Santa Clara		916	75	58	4		31	207	3	1
Santa Cruz	1,733	1.453	62	238	4	5	95	297	6	17
Shasta	307	305	17	127	1		5	40		1
Sierra	49	49	3	4			2	3		
Siskiyou	521	521	69	268		3		92		2
Solano	1.090	1.043	36	165			32	178	4	1
Sonoma	1,162	1.162	32	257	6		7	137	1	2
Stanislaus	1,750	1,750	42	318	18	1	16	347	25	1
Sutter	546	546	28	83	1	4	10	50	4	1
Tehama	281	247	1	66	1			15	1	
Trinity	39	39		27	1			4		
Tulare	603	603	15	347	40		2	27		
Tuolumne			9	61			5	25		
Ventura	1,107	826	34	153	8		39	82	5	4
Yolo	127	8		26		1	3	9		
Yuba	471	471	10	43			11	19		1
Totals	87.883	83.957	3.065	18.380	782	147	8.894	20.650	922	1.032

APPARATUS INSPECTED, 1925—Continued.

Scales—Concluded.

County	Computing				Platform			
	Corrected	Sealed	Out of order	Condemned and confiscated	Corrected	Sealed	Out of order	Condemned and confiscated
Alameda	1,390	2,060	571	7	1,204	1,357	547	26
Amador	7	29	-------	-------	8	32	3	-------
Butte	103	857	9	-------	5	107	1	-------
Calaveras	6	23	-------	-------	12	36	3	-------
Colusa	9	78	2	-------	7	96	8	-------
Contra Costa	120	462	31	4	254	671	115	15
Del Norte	36	36	-------	1	47	47	-------	-------
El Dorado	7	30	-------	-------	7	42	-------	-------
Fresno	332	514	53	-------	625	321	22	6
Glenn	5	75	1	-------	4	85	9	-------
Humboldt	437	437	-------	-------	416	416	-------	-------
Imperial	31	435	5	-------	58	521	3	2
Inyo	34	61	4	1	33	63	1	1
Kern	128	372	29	-------	68	262	5	-------
Kings	35	125	2	-------	71	199	10	1
Lake	7	35	-------	-------	4	56	-------	2
Lassen	7	44	1	-------	30	86	1	-------
Los Angeles	5,482	11,182	1,105	36	2,446	4,954	416	19
Madera	45	61	1	1	55	122	4	4
Marin	48	158	6	3	67	238	9	1
Mariposa	9	9	1	-------	8	11	-------	-------
Mendocino	34	124	1	2	33	118	8	4
Merced	43	149	5	-------	66	311	25	-------
Modoc	7	48	-------	-------	3	55	-------	-------
Monterey	92	246	3	-------	54	140	3	-------
Napa	45	62	8	-------	33	62	5	2
Nevada	19	52	4	-------	17	49	2	-------
Orange	334	651	1	22	233	417	-------	5
Placer	68	288	2	-------	105	309	3	-------
Plumas	20	42	1	-------	11	49	2	1
Riverside	242	243	4	-------	266	266	4	2
Sacramento	117	959	24	-------	116	569	29	2
San Benito	58	5	-------	28	66	6	-------	-------
San Bernardino	49	425	5	-------	50	327	4	-------
San Diego	832	3,457	178	9	327	1,547	68	8
San Francisco	613	5,237	139	1	845	3,560	150	3
San Joaquin	202	623	35	2	302	566	59	8
San Luis Obispo	290	152	62	2	502	269	71	4
San Mateo	164	513	32	-------	64	259	5	3
Santa Barbara	166	350	2	1	179	280	80	2
Santa Clara	183	472	52	2	251	156	16	2
Santa Cruz	283	416	20	1	171	296	9	3
Shasta	11	91	-------	-------	24	143	-------	-------
Sierra	5	13	-------	-------	8	10	-------	-------
Siskiyou	28	123	-------	-------	47	192	-------	-------
Solano	101	351	8	-------	47	192	-------	-------
Sonoma	77	475	-------	-------	130	684	2	-------
Stanislaus	71	407	12	-------	144	890	36	1
Sutter	69	112	6	3	201	284	29	9
Tehama	12	92	5	-------	5	86	4	-------
Trinity	-------	17	-------	-------	-------	14	-------	-------
Tulare	42	177	7	-------	74	298	13	1
Tuolumne	9	48	-------	-------	8	48	-------	-------
Ventura	63	182	9	-------	93	278	16	1
Yolo	1	9	-------	-------	8	45	-------	1
Yuba	56	80	-------	-------	45	100	3	3
Totals	12,684	33,778	2,446	126	9,957	22,597	1,791	142

Apparatus Inspected, 1925—Continued.

Scales and Weights.

County	Wagon, Stock and Track				Weights			
	Corrected	Sealed	Out of order	Condemned and confiscated	Corrected	Sealed	Out of order	Condemned and confiscated
Alameda	101	44	45	2	1,627	12,674	744	295
Amador	2	13	1	--------	25	368	--------	9
Butte	9	99	3	--------	7	335	--------	9
Calaveras	2	17	9	--------	1	408	--------	9
Colusa	4	44	2	--------	2	519	--------	5
Contra Costa	51	94	34	5	270	2,768	--------	52
Del Norte	2	--------	--------	--------	106	--------	--------	--------
El Dorado	2	6	--------	--------	--------	265	--------	1
Fresno	382	62	71	17	480	6,899	42	76
Glenn	1	29	--------	--------	8	361	--------	9
Humboldt	17	--------	--------	--------	1,124	--------	--------	--------
Imperial	8	131	3	2	4	464	1	1
Inyo	4	11	2	--------	88	340	--------	42
Kern	18	84	6	--------	7	811	2	3
Kings	20	64	11	--------	72	1,058	3	10
Lake	4	15	--------	--------	4	243	--------	3
Lassen	11	30	2	--------	68	279	--------	--------
Los Angeles	200	336	108	1	275	48,175	18	563
Madera	15	35	6	--------	152	797	52	8
Marin	2	1	--------	--------	10	1,713	--------	16
Mariposa	--------	4	--------	--------	12	54	--------	--------
Mendocino	10	26	13	3	37	875	--------	13
Merced	13	88	25	--------	6	1,536	--------	3
Modoc	1	26	3	--------	--------	459	--------	--------
Monterey	14	38	4	--------	8	274	--------	2
Napa	11	42	8	1	--------	689	5	19
Nevada	2	4	--------	--------	--------	295	--------	--------
Orange	38	81	--------	7	--------	5	--------	--------
Placer	10	16	--------	--------	45	1,571	--------	1
Plumas	--------	23	4	--------	7	396	--------	8
Riverside	43	43	8	--------	2	1,223	--------	4
Sacramento	2	138	3	2	21	3,651	--------	4
San Benito	5	51	8	--------	29	478	2	1
San Bernardino	11	185	7	--------	--------	860	--------	--------
San Diego	11	45	4	--------	35	7,015	--------	68
San Francisco	--------	--------	--------	--------	138	21,434	34	46
San Joaquin	145	98	52	1	43	4,404	--------	56
San Luis Obispo	186	89	50	--------	180	173	--------	51
San Mateo	17	47	2	--------	--------	985	--------	1
Santa Barbara	65	70	13	1	9	2,842	--------	3
Santa Clara	34	26	1	--------	33	1,163	11	--------
Santa Cruz	22	31	6	--------	43	2,487	--------	12
Shasta	4	34	3	--------	--------	1,032	--------	--------
Sierra	1	4	--------	--------	--------	81	--------	2
Siskiyou	38	127	--------	--------	115	2,124	--------	--------
Solano	27	52	--------	--------	13	854	--------	45
Sonoma	14	72	--------	--------	13	3,376	--------	--------
Stanislaus	60	216	59	--------	38	4,459	232	21
Sutter	115	150	23	2	220	1,570	--------	11
Tehama	4	21	3	7	--------	567	2	3
Trinity	1	2	--------	--------	--------	138	--------	--------
Tulare	32	81	10	--------	15	1,624	--------	13
Tuolumne	--------	--------	--------	--------	--------	65	--------	--------
Ventura	18	85	13	--------	6	1,410	--------	14
Yolo	4	38	--------	1	2	280	--------	7
Yuba	3	25	3	--------	16	688	--------	14
Totals	1,816	3,193	628	52	5,416	149,594	1,148	1,533

APPARATUS INSPECTED, 1925—Continued.

Measures.

County	Lineal				Liquid			
	Corrected	Sealed	Out of order	Condemned and confiscated	Corrected	Sealed	Out of order	Condemned and confiscated
Alameda	34	107	34		277	3,958	68	21
Amador		6		4		139		2
Butte		35				162		
Calaveras					1	204		19
Colusa						43		
Contra Costa		8			10	851		32
Del Norte	835				218			
El Dorado						80		2
Fresno		7			66	3,141	67	3
Glenn						3		
Humboldt	3,825				2,367			
Imperial	38	351	3		6	185		1
Inyo		5			20	94	44	9
Kern						148		2
Kings						116		1
Lake	3	11			5	108		8
Lassen	2	16			7	74		1
Los Angeles		926	10	176	54	39,051	190	220
Madera		7		37	3	456		8
Marin		60				1,507		16
Mariposa					1	20		
Mendocino	3	4		23	2	400		12
Merced						554		3
Modoc						83		1
Monterey					3	724		
Napa		17		2		1,057		26
Nevada	1					26		
Orange					2	367		6
Placer					10	500		
Plumas		9		1	2	177		2
Riverside					9	691		1
Sacramento		7			19	1,354		
San Benito						63		6
San Bernardino		10				861		1
San Diego	94	3				3,740		129
San Francisco	39,956				1	59,154	65	72
San Joaquin	1	34		1	37	2,264	5	10
San Luis Obispo	40	346		54	332	173	67	1
San Mateo					2	1,917		2
Santa Barbara	1	116			3	1,451		2
Santa Clara					6			
Santa Cruz						1,247		9
Shasta		28				470		
Sierra		1				51		3
Siskiyou		5				542		
Solano		9			9	789		3
Sonoma		4				451		
Stanislaus		1			3	597	2	15
Sutter		6			1	106		1
Tehama						26		
Trinity								
Tulare						959		2
Tuolumne		33			3	337		
Ventura					1	595		5
Yolo						75		1
Yuba		35				503		17
Totals	44,833	2,237	47	298	3,484	132,505	647	673

APPARATUS INSPECTED, 1925—Continued.

County	Measuring pumps				Milk bottles			
	Corrected	Sealed	Out of order	Condemned and confiscated	Corrected	Sealed	Out of order	Condemned and confiscated
Alameda	1,899	1,811	427	3	230,380			1,920
Amador	10	15	2					
Butte	46	337	11		576	10		10
Calaveras	20	27	9		160			
Colusa	26	78	15		72			
Contra Costa	374	533	74	2				
Del Norte	207							
El Dorado	12	61	3		7			
Fresno	527	1,362	151	4			12	
Glenn	25	82	8					
Humboldt	242				1,008			
Imperial	38	351	3	4	332	9	1	
Inyo	42	48	10	1				
Kern	122	330	20					
Kings	84	167	28		2,376			
Lake	16	55	3		521	27		
Lassen	38	52	5		265	10		
Los Angeles	2,004	4,512	1,467	1	5,280,123			
Madera	74	106	11		2,525			
Marin	18	499	7	2	57,700			34
Mariposa	4	23	6					
Mendocino	75	99	27	2	282	128	154	
Merced	37	451	30					
Modoc	1	48						
Monterey	275	400	29		1,000			
Napa	49	116	8	1	4,000			
Nevada	52	15	4		30			
Orange	236	547		50	600			
Placer	81	186	7		2,555	31		
Plumas	12	22	2		890			
Riverside	509	519	20					
Sacramento	230	317	19	1	50,000			
San Benito	15	19	8					
San Bernardino	99	457	27		260			
San Diego	286	2,132	58	2	48,240	23,806	23,516	918
San Francisco	240	2,766	104		7,196,332			180,396
San Joaquin	327	1,049	107					
San Luis Obispo					12,734	449		449
San Mateo	323	945	99		31,164			2,842
Santa Barbara	203	479	14		20,000			
Santa Clara	144	446	19					
Santa Cruz	218	385	30					
Shasta	14	156	1		3,925			
Sierra	5	9	2					
Siskiyou	63	186		1	100	4	82	
Solano	157	253	1		29,880	33	16	
Sonoma	145	433	4		288			
Stanislaus	56	488	30	1				
Sutter	75	94	17	1				
Tehama	36	111	16					
Trinity	6	17	5					
Tulare	191	556	36					
Tuolumne	17	58			174			
Ventura	201	424	29					
Yolo	21	37	2	1				
Yuba	23	38	11		3,181			
Totals	10,250	24,752	3,039	79	16,981,680	24,507	23,781	185,603

APPARATUS INSPECTED, 1925—Continued.

County	Miscellaneous				Totals Exclude milk bottles and containers)			
	Corrected	Sealed	Out of order	Condemned and confiscated	Corrected	Sealed	Out of order	Condemned and confiscated
Alameda		5,285		310	7,659	24,443	2,945	419
Amador					54	631	9	15
Butte								
Calaveras		4	5	2				
Colusa					56	942	31	5
Contra Costa	4	5			1,165	5,775	289	133
Del Norte								
El Dorado								
Fresno	138	316	1	3	2,899	13,179	433	123
Glenn					46	693	25	9
Humboldt								
Imperial	5	75	1	1	175	3,651	31	21
Inyo	1	3			252	685	62	54
Kern								
Kings					337	1,865	68	18
Lake								
Lassen	7	8			195	661	10	5
Los Angeles	358	1,439	55	7	17,511	123,745	3,686	1,812
Madera					360	1,677	78	68
Marin		1,030			204	4.501	32	54
Mariposa					39	134	10	
Mendocino		107			213	1,873	52	66
Merced					189	3,202	90	7
Modoc	2	19			22	781	3	1
Monterey	2	4			493	1,938	40	3
Napa								
Nevada								
Orange					911	2,333	2	109
Placer	15	34			370	3,110	19	4
Plumas					57	753	11	12
Riverside	27	36		4	1,391	3,315	40	17
Sacramento					559	8,678	127	10
San Benito					131	794	32	6
San Bernardino					274	3,440	45	1
San Diego	10	57	3		2 028	20,921	423	219
San Francisco					2,429	139,522	594	150
San Joaquin	109	662	25	38	1,297	10,247	318	124
San Luis Obispo					1,645	1,374	269	135
San Mateo					605	4,864	143	7
Santa Barbara	401	180	614		1,123	6,035	654	9
Santa Clara		2,571						
Santa Cruz	2	24		8	876	5,421	75	55
Shasta					75	2,121	5	1
Sierra					24	175	2	3
Siskiyou					360	3,657		6
Solano		11			422	3,052	10	49
Sonoma					415	5,889	12	2
Stanislaus					430	7,696	417	38
Sutter				38				
Tehama		2	1		65	986	33	3
Trinity					7	219	6	
Tulare	371	4,069	106	16				
Tuolumne								
Ventura		11						
Yolo								
Yuba					163	1,552	27	32
Totals	1,452	33,952	801	427	47,526	421,406	11,158	3,785

APPARATUS INSPECTED, 1925—Concluded.

County	Packages or containers inspected		
	Heavy	Correct	Light
Alameda	40,712	46,321	3,117
Amador	260	1,482	24
Butte		9,290	
Calaveras			
Colusa	3	726	11
Contra Costa	360	488	225
Del Norte	385	4,350	
El Dorado		55	12
Fresno		82,008	1,384
Glenn	2	731	19
Humboldt	2,945	29,145	
Imperial		150,886	1,203
Inyo	16	52	55
Kern	4	8,851	999
Kings		9,878	35
Lake		1,437	420
Lassen	2	30	
Los Angeles	7,732	32,024	10,239
Madera		15,285	1,020
Marin		59,171	152
Mariposa			
Mendocino	147	315	104
Merced	9	4,766	1,105
Modoc	336	170	130
Monterey	1,300	1,060	
Napa		3,752	1,968
Nevada	63	225	82
Orange			
Placer			70
Plumas		1,644	82
Riverside	52	17,818	84
Sacramento	6,178	40,975	2,360
San Benito			
San Bernardino		4,604	160
San Diego	16,484	33,960	14,889
San Francisco		609,776	1,568
San Joaquin	45	1,210	592
San Luis Obispo		9,676	25
San Mateo		66,850	237
Santa Barbara	50	3,614	2.419
Santa Clara			
Santa Cruz	138	5,465	2,119
Shasta	22	238	15
Sierra		24	13
Siskiyou	70	20	10
Solano	4	13,627	45
Sonoma	125	469	275
Stanislaus		2,178	122
Sutter		38,206	
Tehama	4	1,020	17
Trinity		412	9
Tulare	115	15,464	3,066
Tuolumne			
Ventura			
Yolo			
Yuba	105	15.067	218
Totals	77,668	1.344,635	47,580

MARKET NEWS SERVICE.

By O. W. HOLMES, State Representative.

C. J. HANSEN and W. E. SCHNEIDER, Representatives U. S. Bureau of Agricultural Economics.

FRUITS AND VEGETABLES.

It has been stated by the best authority that marketing is the other half of agriculture, and this is especially true of highly perishable products like fruits and vegetables. The necessity of getting them to satisfactory consuming markets promptly and in good condition is a most important problem for the grower and shipper. This can be accomplished to a considerable degree by proper grading and packing in standard packages. In this way the best prices are to be secured, especially when the goods arrive in competition with products from other sections.

FINDING A MARKET.

The grower and shipper must also decide whether it will be to his advantage to sell his product at point of production or consign to markets outside the state. When the products are sold at shipping point the grower avoids all risk of weak or declining markets but loses a chance of obtaining greater returns from advancing prices. To assist the grower and shipper in deciding these important questions, the California Department of Agriculture and the United States Department of Agriculture have inaugurated this Market News Service.

MARKET PRICES CAREFULLY OBTAINED.

Trained men are stationed at the important markets in the state to obtain daily prices in various agricultural commodities. They mingle with the buyer and the seller, note the quality of the stock arriving and obtain the prevailing prices for the day. To further assist the grower and shipper in selecting a desirable market to which he may ship his products the Department of Agriculture reports prices on many eastern markets, obtained directly by leased wires. All of this information, together with receipts, prices and trend of markets, is included in various mimeographed reports sent free to persons desiring them. Hundreds of growers, shippers, wholesalers, retailers, county agents and railroads find these reports very valuable because they are accurate, unbiased and obtained by practical experts in their line. Frequently these reports are used by railroads in settling claims of shipper or receiver.

Below is given a list of the various market reports issued throughout the year:

Potato report—Issued practically throughout entire year.
Lettuce report—Issued from April to December.
Onion report—Issued throughout most of year.
Apple report—Issued from July to end of year.
Grape report—Issued from August to November 20th.
Peach, pear and plum report—Issued during the shipping season.
Artichoke report—Issued from November to March next year.

Miscellaneous shipments report—Issued during entire year.
Miscellaneous San Francisco market report—Issued throughout year.
Live poultry report—Issued throughout year.
Cold storage report—Issued semi-monthly throughout year.

REPORTS BROADCASTED BY RADIO.

In addition to the several mimeographed market reports, special reviews and summaries are issued at certain times during the year. Many of these are from fourteen to twenty pages in length and cover such deals as the grape, peach, pear, artichoke, onion and asparagus reviews. Special market reports are also prepared for radio broadcasting.

SPECIAL NEWS SERVICE.

This office has recently completed arrangements for the issuance of special market reports on asparagus to begin about the 1st of March. The growers and shippers interested in the marketing of asparagus have formed an association and have agreed to furnish an additional clerk and pay the total cost of a special telephone service to growers and shippers in the delta region. It is hoped that this will help to find new markets for asparagus and will prevent the overloading of some of the large markets, resulting in better returns to shippers. The 1925 asparagus season was very unsatisfactory and in many instances the returns were not sufficient to pay the freight and packing charges.

MAILING LIST LARGE.

Between 1500 and 2000 growers, shippers, dealers and consumers are included in the mailing list and receive reports daily on one or more commodities. It is estimated that approximately one million sheets of paper are used during the year for these market reports. The potato, onion, grape, miscellaneous shipment, miscellaneous San Francisco market and the semi-monthly cold storage reports are in greatest demand, but the other reports are quite popular among those interested in certain crops.

COLD STORAGE HOLDINGS.

Of special importance is the cold storage and public warehouse information furnished growers, shippers and dealers on the 15th and 30th of each month by this department. All cold storage plants and public warehouses are required to report to this office twice monthly their total holdings of potatoes, apples and onions in sacks and boxes.

These figures are immediately tabulated and reported to the trade in general. This report has been well received and requests for it are made from persons as far distant as Chicago.

AID TO BETTER MARKETING.

The Market News Service on certain agricultural products is offered as an aid to better marketing, by enabling everyone to keep in closer touch with market conditions. No attempt is made to fix prices, to regulate or control distribution or to interfere with legitimate trade practices. This office acts as a clearing house for reliable market information, the dissemination of which tends to stabilize prices and establishes greater confidence between seller and buyer. The publication of reliable market information tends to stimulate healthy competition, to discourage unfair practices and to generally improve marketing methods.

RECOMMENDATIONS.

After due thought and consideration it is felt that the State of California, through the agency of the Department of Agriculture, might well afford to appropriate some additional funds for the Market News Service. If funds for an additional stenographer and expenses in connection with the offices were provided it would be possible to satisfactorily complete the work as outlined by the cooperative offices.

LIVE STOCK, MEATS AND WOOL REPORTING SERVICE.*

1. The past year developed practically no outstanding accomplishments in the work of the Division of Live Stock, Meats and Wool at San Francisco. Range and pasture conditions were about ordinary, resulting in a fairly liberal supply of live stock throughout the season.

NEW FEATURES.

2. During the period March 15th to June 1st special telegraphic summaries of trade on California dressed lambs at Atlantic Coast markets were received via leased wire; these in turn were disseminated to our branch office in Los Angeles and to the Secretary of the California Wool Grower's Association. Many growers and killers on the Pacific Coast were thus kept informed as to the advisability of moving dressed lambs from California to Eastern markets. Shipments during this period were approximately 92 refrigerator cars or 59,000 head. During the same period similar reports were received from Middle Western live stock markets advising as to sales, weights and quality of California lambs which were then being shipped freely out of the state. The total number of live California spring lambs shipped East approximates 212,000 head. Through the cooperation of our Ogden live stock office passing point reports were received on California lambs; these were released to the trade at San Francisco and Los Angeles as well as at Middle Western markets. Considering the quality of California live spring lambs for the past season, it has been freely stated that the markets absorbed the crop in a satisfactory manner. During the season of 1926 California lambs were distributed at ten leading markets. This wide distribution is significant inasmuch as during 1923 only seven markets were used. From July to November special grass cattle market information was released on the Pacific Coast from the San Francisco market only, depicting sales, weights and quality, states of origin and pertinent comment as to the reception of grass cattle at Middle Western markets. It is to be regretted that the information concerning the marketing of grass cattle does not meet as ready a reception in California as do the market comments on California lambs.

---

* Because of the delayed publication of the 1925 Annual Report, the live stock news service includes the first six months of 1926.

METHOD OF REPORTING.

3. Because of the fact that there is no centralized market at San Francisco and the live stock supply is somewhat seasonal, the slaughterers located here are compelled to buy their supplies in large volume and hold until needed. These conditions make the reporters' problems more difficult than at any other market. The reporter at San Francisco obtains information by making daily visits to the leading packing plants, observing the quality and grade of stock on hand and inspecting killer's purchase records. Head live stock buyers, dressed meat salesmen, jobbers and retailers are questioned as to the general tone of the market. By observing supply in coolers a fairly accurate word-picture can be obtained for the readers of his reports. Certain other information is obtained from the representatives of the California Wool Grower's Association and the California Cattlemen's Association as to sales and conditions at country buying points.

PROGRESS MADE IN NEW DISSEMINATION.

4. For the past fiscal year approximately 70 stencils per month have been run on the mimeograph machine consisting of 285 daily reports on live stock trade conditions, 285 Weekly Wool Market reports and 135 Weekly Live Stock Market reviews. About 180 Meat Trade reviews are released weekly in addition to a short report for 50 country newspapers on live stock trading conditions at San Francisco. An average of four additional miscellaneous stencils has been issued per month consisting of the following:

Sheep and lamb condition reports.
Pig survey.
Annual agricultural outlook.
Cattle on feed reports.
Colorado lamb loadings.
Monthly slaughter in the Bay District.

The daily live stock reports and the weekly wool reports are released to 26 local newspapers having a large city and country mailing list, the aggregate number of copies issued by them totaling around 450,000 daily. The daily live stock report is released to Radio Station KGO, Oakland, which broadcasts daily around 6:30 p. m., reaching a great number of farmers in California, Nevada, Oregon and Arizona. The dissemination of live stock reports to the Commercial Press Association covers all of California, parts of Oregon, Nevada and Arizona. The following press services pick up the live stock report at 10:30 a. m. in our office:

International News Service.
The Associated Press.
Consolidated Press.
Western Union CND Service.

SPECIAL NEWS ARTICLES.

5. A weekly review of the current eastern lamb market and the current Middle Western Live Stock market was issued each Saturday during the period March 15th to June 15th. These special 200-word

articles were received with generous approval by the members of the live stock trade, growers and news agencies, many of them expressing appreciation of their aptitude and timeliness. These articles featured the high lights in the weekly trade as affecting California meat trade interests and were used by Radio Station KGO, Oakland, to supplement and enliven their daily market releases. The paramount idea back of all the work in California this year was to make the information timely and to curtail to the minimum the expense incident to issuance of material so as to relieve the burden on the mechanical department as well as the clerical staff.

STATISTICAL STUDIES.

6. At the conclusion of the year 1925 a two-page summary on the high lights of trading at San Francisco was released. Detailed records of arrivals of live stock for the Bay District by day, weeks and months have been kept during the past year, this information being received over telephone by the live stock clerk from the local freight offices located at Butchertown Stock Yards and South San Francisco. A comprehensive summary of the California early spring lamb deal was prepared and submitted to the Washington office for approval. The purpose of the publication was to review the expense and factors which developed during the California marketing season. Much of the information contained in this bulletin was tabulated in the San Francisco office. During the marketing season of 1926 all valuable information and statistics have been recorded and a similar study on beef cattle marketing is in process of preparation.

MEAT GRADE INSPECTION.

7. Meat grade inspection for the U. S. Shipping Board, Emergency Fleet Corporation, was conducted throughout the past fiscal year at no increase in clerical or technical personnel. The value of the meats inspected for grade, quality and condition during the year was about $2,500.00. This represents a curtailment from a year ago due to the fact that the Shipping Board has reduced its personnel through the sales of eight or nine laid up vessels.

ADMINISTRATION.

8. There has been no increase in personnel and no turnover or replacement during the past year despite a large increase in volume of business. About six additional stencils per month have been run as compared to a year ago. Relay work from the terminus of the leased wire to Los Angeles and North Portland, Oregon, has also been taken care of.

The officer in charge made four trips during the year to Davis, California, on the following occasions to represent the work of the Bureau in California:

Lamb Feeders Day, January 22 and 23, 1925
Cattle Feeders Day, May 16, 1925.
Annual Ram sale, May 30, 1926.
Animal Husbandry Short Course, June 14 to 16, 1926.

Additional trips were made, one to Woodland and the other to Fresno, attending meetings of California sheepmen and another to Santa Rosa to attend a sheep mating and wool grading demonstration. On October 29th a special meeting of retail meat dealers in San Francisco was attended to discuss the high cost of carcass lambs. Charts illustrating monthly slaughter prices at principal markets of live lambs and dressed carcasses were presented. At the conclusion of the open meeting of the Butchers Board of Trade, a resolution was adopted asking retailers not to boycott lambs. During the first part of November the writer delivered a paper on the marketing of California lambs at the annual convention of the California Wool Grower's Association in San Francisco.

PERSONNEL.

9. W. E. Schneider, Assistant Marketing Specialist, Miss Norah P. Houston, Assistant Clerk, Warren A. Thoman, Telegrapher, William Hopson, Mimeograph operator.

QUARTERS.

10. The Live Stock, Meats and Wool Division has vacated room 2, Ferry Building, in favor of the new State Chief, Division of Markets. Our office is now located in a small room approximately 12x14 feet northwest corner, Room 1, Ferry Building. It is believed the division office here has the most favorable location at the present time since its establishment early in 1922 in San Francisco.

* * *

CALIFORNIA CROP REPORT FOR 1925.

E. E. Kaufman, Agricultural Statistician.

The annual production survey of California agriculture for 1925 reveals general success within the state and an excellent comparison with other states. An estimated valuation of all crops in the various states entitles California to a rank of second place. Of the main field and fruit crops alone 11,704,000 tons were harvested in 1925 compared to 9,760,000 tons in 1924. The total value to the farmer of main field, fruit and vegetable crops was $473,897,000 compared to $437,755,000 a year ago.

It should be remembered however that the crop year of 1924 was made severe by drought and it is not surprising that 1925 brought more general success to California farmers. From the whole state better yields were harvested from more acres, although the average price scale was less satisfactory.

This report summarizes the production of California field, fruit and vegetable crops for 1925, and in tabular form briefly tells the story of California crop production for the past year in comparison with previous years. Other production reports released during the year have been but forecasts based on preliminary estimates of acreages and prevailing crop conditions during the growing season. Embodied in this report are final estimates for the year of all main crops, except live stock and live stock products, obtained by a thorough revision of the preliminary estimates of acreage and yields per acre. The estimates here recorded for 1924 have been revised in accordance with all reliable data now available on acreage and production. The 1925 estimates are subject to a similar revision one year hence. Some valuable data have been drawn from the Census of Agriculture taken by the U. S. Bureau of the Census, for the crop year 1924.

The valuation of all crops is based on the average price to the grower prevailing on December 1 or on an average price during the harvest season, delivered at the home-town market, shipping station or packing shed.

To compare total production of all crops one year with another it is necessary to reduce all crops to a common measure. Unless otherwise indicated production is recorded in tons.

In Table I are given estimates of the acreage, production in tons and farm value to the grower of the main field crops; the estimated tonnage and value of the main fruit crops; and the estimated acreage and value only of the vegetable crops produced during the past seven years.

TABLE I.—*Acreage, Production and Value of California Crops.*

Year	Acreage	Production (tons)	Average value per ton	Farm value December 1
FIELD CROPS.				
1925	4,551,200	8,104,100	$23 87	$193,484,000
1924	3,981,200	6,743,600	27 56	185,822,000
1923	5,256,000	8,316,500	24 05	200,009,000
1922	5,321,000	8,147,186	22 47	183,041,000
1921	5,208,000	8,231,916	17 60	144,863,000
1920	5,690,000	8,282,526	28 44	235,553,000
1919	5,876,000	8,134,749	35 91	292,146,000
FRUIT CROPS.				
1925	1,502,500	3,599,900	63 44	228,366,000
1924	1,369,600	3,016,900	67 91	204,869,000
1923	1,303,800	3,653,500	47 67	174,166,000
1922	1,227,800	2,997,500	66 93	200,611,000
1921	1,122,600	2,153,300	83 58	179,964,000
1920	1,021,400	2,640,550	88 07	232,557,000
1919	938,400	2,651,050	91 14	241,628,000
VEGETABLE CROPS.				
1925	247,800			52,047,000
1924	220,800			47,064,000
1923	213,950			62,668,000
1922	187,570			53,566,000
1921	145,770			29,968,000
1920	170,650			39,210,000
1919	167,340			33,411,000

In Table II are shown other comparisons of totals of the main field, fruit and vegetable crops, relative to acreage, tonnage and valuation for 1924 and 1925.

TABLE II.—*Comparisons of Totals of Field, Fruit, and Vegetable Crops for 1924 and 1925.*

	1924	1925	1925 expressed as per cent of 1924
Total acreage in main field crops	3,981,200	4,551,200	114.3
Total bearing acreage in main fruit crops	1,369,600	1,502,500	109.7
Total acreage in vegetable crops	220,800	247,800	112.2
Total tonnage of main field crops	6,743,600	8,104,100	120.2
Total tonnage of main fruit crops	3,016,900	3,599,900	119.3
Grand total tonnage of field and fruit crops	9,760,500	11,704,000	119.9
Tonnage of main field crops expressed as per cent of total tonnage of field and fruit crops	69.1	69.2	
Tonnage of main fruit crops expressed as per cent of total tonnage field and fruit crops	30.9	30.8	
Total value—main field crops	$185,822,000	$193,484,000	104.1
Total value—main fruit crops	204,869,000	228,366,000	111.5
Total value—vegetable crops	47,064,000	52,047,000	110.6
Grand total value—all main crops	$437,755,000	$473,897,000	108.3
Field crops—value expressed as per cent of total value all crops	42.4	40.8	
Fruit crops—value expressed as per cent of total value all crops	46.8	48.2	
Vegetable crops—value expressed as per cent of total value all crops	10.8	11.0	
Value of average ton of field crops	$27 56	$23 87	86.6
Value of average ton of fruit crops	67 91	63 44	93.4
Field crops—average value per harvested acre	$46 67	$42 51	91.1
Fruit crops—average value per acre of bearing fruit	149 58	151 99	101.6
Vegetable crops—average value per harvested acre	213 15	210 04	98.5

TABLE III.—*Ranking of Twenty Most Valuable Crops in California, 1924 and 1925.*

Rank	1924		Rank	1925	
	Crop	Value		Crop	Value
1	Hay (tame)	$100,797,000	1	Oranges	$79,200,000
2	Oranges	65,629,000	2	Hay (tame)	75,796,000
3	Wine grapes	22,050,000	3	Barley	24,180,000
4	Lemons	17,835,000	4	Raisin grapes	23,850,000
5	Barley	17,246,000	5	Wine grapes	22,910,000
6	Raisin grapes	15,500,000	6	Beans	18,737,000
7	Prunes	15,290,000	7	Lemons	18,000,000
8	Table grapes	13,000,000	8	Wheat	16,956,000
9	Beans	12,568,000	9	Prunes	15,950,000
10	Peaches	11,550,000	10	Cotton	14,590,000
11	Apples	10,862,000	11	Peaches	14,430,000
12	Walnuts	10,350,000	12	Walnuts	13,420,000
13	Cotton	9,961,000	13	Lettuce	13,134,000
14	Lettuce	9,837,000	14	Potatoes	13,020,000
15	Cantaloupes	9,630,000	15	Cantaloupes	9,872,000
16	Asparagus	8,799,000	16	Pears	9,412,000
17	Pears	8,778,000	17	Rice	8,055,000
18	Wheat	8,709,000	18	Table grapes	7,776,000
19	Sugar beets	7,321,000	19	Asparagus	7,698,000
20	Rice	7,246,000	20	Tomatoes	7,678,000

SEASONAL CONDITIONS

The unusually dry season of 1924 was followed in 1925 with more nearly normal precipitation. However, rainfall was below the normal in most sections of the southern half of the state, particularly in the southern counties. In some of the interior valleys where much irrigation water is supplied from wells there was an important decline of ground water levels. This necessitated the deepening of wells and lowering of well machinery while in some instances an actual water shortage was experienced.

Climatic conditions were generally favorable through early spring excepting in the southern counties where rainfall was deficient. In March a light frost occurred in local areas of the interior valleys while deciduous fruits were in flower. In those areas injury was not severe, only reducing the later thinning of such fruits. In some localities early grape growth was slightly frosted. During early April the entire state received a beneficial rain, followed by good growing weather. On the nights of April 21st and 22d some localities reported light frost damage to deciduous fruits.

Late April and May brought mixed and irregular weather conditions. Rainfall was heavier than normal for late spring accompanied by cool weather that retarded seeding and development of various crops. Two storm periods during the middle of May developed heavy rainfall which in some areas was detrimental to the maturing barley crop and to hay crops that were being harvested.

Early June was cool followed by a heat period later in the month when maximum temperatures in many localities equalled or exceeded all previous records for June. Another period of exceedingly high temperatures followed in mid-July. In certain localities limited heat damage resulted to oranges, grapes, prunes, peaches, walnuts, melons, beans, hops and cotton. Conditions were very favorable during late July and early August. However, the latter half of August and September brought unseasonably cool nights which somewhat retarded the maturing of grapes, rice and cotton. Local showers and heavy dews in September caused some interference in drying of fruits.

October weather was most satisfactory as a harvest month. Frosts during early November throughout the Sacramento and San Joaquin valleys stopped the growth of cotton. Over this area moist weather prevailed during late November and throughout December, mostly in the form of land fog. This condition was extremely detrimental to the maturing and harvesting of the second picking of cotton.

As seasonable averages go 1925 may be viewed as a satisfactory agricultural year for the state.

The character of the recent crop seasons in California is indicated in Table IV which shows the composite condition of all important crops during months of the growing period, in which 100 represents an average (not normal) condition.

TABLE IV.—*Monthly Composite Crop Conditions, 1915-1925.*

	June 1	July 1	August 1	Sept. 1	Oct. 1
1915	112.8	106.7	103.8	101.7	103.5
1916	92.0	95.2	96.4	99.8	101.2
1917	104.5	100.3	97.7	97.6	101.3
1918	98.0	94.2	92.6	89.0	86.5
1919	105.0	101.8	98.0	98.9	100.5
1920	95.8	95.4	96.8	96.5	95.7
1921	96.5	95.0	94.8	95.1	94.7
1922	98.9	100.4	101.7	102.3	101.2
1023	105.9	106.1	106.3	105.7	109.5
1924	87.1	87.2	87.9	85.0	89.4
1925	102.9	103.7	100.5	97.1	107.8

WAGES OF FARM LABOR

There was a slight increase in the wages paid for farm labor in 1925 as compared with the previous year. In view of the statewide interest in the question of farm labor there are shown in Table V the average wages paid per day for hired farm labor, without board and with board, at times other than harvest, for California; the eleven western states including California; the United States including California; and a percentage comparison of California farm wages and the United States.

TABLE V.—*Wages of Farm Labor—Average per Day, Other Than Harvest Time.*

	Without Board				With board			
	California	Eleven Western States	United States	California compared with U.S. per cent	California	Eleven Western States	United States	California compared with U.S. per cent
1925*	$3 60	$2 91	$2 40	150	$2 70	$2 49	$1 89	143
1924*	3 40	3 16	2 43	140	2 40	2 33	1 87	128
1923	4 00	3 47	2 45	163	3 12	2 60	1 84	170
1922	3 40	3 00	2 15	158	2 53	2 23	1 65	153
1921	3 35	3 01	2 18	154	2 [illegible]	2 26	1 68	152
1920	4 60	4 61	3 59	128	3 60	3 66	2 86	126
1919	3 90	4 02	3 12	125	2 99	3 08	2 45	122
1918	3 25	3 52	2 63	124	2 60	2 76	2 07	126
1917	2 67	2 82	2 02	132	2 04	1 87	1 56	131
1916	2 17	2 24	1 62	134	1 57	1 67	1 26	125
1915	2 10	2 08	1 47	143	1 55	1 54	1 13	137
1014	2 05	2 09	1 45	141	1 44	1 52	1 13	127
1913	2 01	2 07	1 50	134	1 44	1 52	1 16	124
1912	2 03	2 06	1 47	138	1 48	1 54	1 14	130
1911	2 05	2 07	1 42	144	1 48	1 51	1 09	136
1910	2 02	2 06	1 38	146	1 44	1 51	1 06	136

*Data for July 1.

FIELD CROPS.

The latest revised estimates of acreage, production and farm value relating to the main field crops of California for years 1919 to 1925 are shown in Table VI. In other tables and the discussion that follows are given more details and additional information.

Corn, Indian—The San Joaquin River Delta remains the important corn producing area of the state where about 51 per cent of the total grain crop is grown. The total acreage of corn produced in California in 1925 was 85,000. Of this total 44,000 acres were for the production of grain while 41,000 acres were grown for silage and other forage purposes. Total production figures recorded in Table VI are based on the assumption that the grain yield per acre on acreage grown for silage and forage would be the same as from that acreage grown for grain. The actual production of corn for grain was therefore only about 1,544,000 bushels as compared to a similar production in 1924 of 1,521,000 bushels. In 1924 there were about 45,000 acres of corn grown for grain and 41,000 acres grown for silage and forage. The average grain yield per acre of corn in 1925 was 35.1 bushels; in 1924, 33.8 bushels. The 1925 yield was less than one bushel above the past ten-year average.

Wheat, Barley and Oats—The production of these small grain crops in 1925 was quite satisfactory in about one-half of the grain producing area of the state. In the remaining portion production ranged from a total crop failure to about an average crop. In the Sacramento Valley and the northern San Joaquin Valley very good yields were produced although the heavy rains of early May caused many fields to lodge, making harvest difficult. The market quality of barley was somewhat reduced by stain caused by these late rains. The weight per bushel was very satisfactory for making export malting barley grades although average prices were reduced due to the high percentage of stained barley. Total acreages of the small grains harvested each year in California are not only dependent on seedings but also on weather conditions that prevail during Autumn, Winter and Spring. In various localities and for the state as a whole the planted acreage each year is disposed of in three ways, namely; harvested for grain, harvested for hay and abandoned for either grain or hay harvest. In Table VII are shown estimates of the total planted and harvested acreages of wheat, barley and oats in California for the past three years, and also grain production recorded in tons. These estimates relate to the entire production of these grains in the state including the grain that is consumed as feed or seed in the territory where grown as well as that portion that enters main trade channels.

TABLE VI.—*Acreage, Production and Value of Specified Field Crops, 1919-1925.*

Crop	Acreage	Production			Farm value, December 1	
		Per acre	Total	Unit	Per unit	Total
Corn 1925	85,000	35.10	2,984,000	Bushels	$1 18	$3,521,000
1924	86,000	33.80	2,907,000	Bushels	1 38	4,012,000
1923	128,000	35.00	4,480,000	Bushels	1 08	4,838,000
1922	116,000	36.00	4,176,000	Bushels	1 00	4,176,000
1921	116,000	35.00	4,060,000	Bushels	0 77	3,126,000
1920	139,000	33.00	4,587,000	Bushels	1 20	5,504,000
1919	149,000	32.00	4,768,000	Bushels	1 79	8,535,000
Wheat 1925	603,000	19.00	11,457,000	Bushels	1 48	16,956,000
1924	377,000	15.00	5,655,000	Bushels	1 54	8,709,000
1923	748,000	21.60	16,157,000	Bushels	1 08	17,450,000
1922	712,000	21.50	15,308,000	Bushels	1 15	17,604,000
1921	557,000	15.00	8,355,000	Bushels	1 07	8,940,000
1920	714,000	14.00	9,996,000	Bushels	1 80	17,993,000
1919	1,087,000	15.50	16,848,000	Bushels	2 04	34,370,000
Oats 1925	151,000	34.40	5,194,000	Bushels	0 61	3,168,000
1924	86,000	20.80	1,789,000	Bushels	0 87	1,556,000
1923	162,000	32.50	5,265,000	Bushels	0 60	3,159,000
1922	150,000	35.00	5,250,000	Bushels	0 64	3,360,000
1921	140,000	27.00	3,780,000	Bushels	0 51	1,928,000
1920	155,000	30.00	4,650,000	Bushels	0 80	3,720,000
1919	147,000	29.00	4,263,000	Bushels	0 96	4,092,000
Barley 1925	1,040,000	31.00	32,240,000	Bushels	0 75	24,180,000
1924	698,000	21.30	14,867,000	Bushels	1 16	17,246,000
1923	1,095,000	30.20	33,069,000	Bushels	0 70	23,148,000
1922	1,129,000	30.50	34,435,000	Bushels	0 63	21,694,000
1921	1,188,000	25.00	29,700,000	Bushels	0 56	16,632,000
1920	1,250,000	23.00	28,750,000	Bushels	1 00	28,750,000
1919	987,000	27.00	26,649,000	Bushels	1 41	37,575,000
Rice 1925	103,000	46.00	4,738,000	Bushels	1 70	8,055,000
1924	90,000	48.50	4,365,000	Bushels	1 66	7,246,000
1923	106,000	53.50	5,671,000	Bushels	1 12	6,352,000
1922	140,000	55.00	7,700,000	Bushels	1 10	8,470,000
1921	135,000	54.00	7,290,000	Bushels	1 15	8,384,000
1920	162,000	51.00	8,262,000	Bushels	1 21	9,997,000
1919	155,000	60.00	9,300,000	Bushels	2 67	24,831,000
Grain Sorghum 1925	88,000	34.00	2,992,000	Bushels	1 07	3,201,000
1924	84,000	30.50	2,562,000	Bushels	1 35	3,459,000
1923	135,000	33.00	4,455,000	Bushels	1 00	4,455,000
1922	130,000	32.00	4,160,000	Bushels	1 00	4,160,000
1921	140,000	31.00	4,340,000	Bushels	0 70	3,038,000
1920	150,000	27.00	4,050,000	Bushels	1 05	4,253,000
1919	168,000	25.50	4,284,000	Bushels	1 54	6,597,000
Beans 1925	240,000	19.00	4,570,000	Bushels	4 10	18,737,000
1924	179,000	13.50	2,417,000	Bushels	5 20	12,568,000
1923	299,000	15.70	4,694,000	Bushels	4 00	18,776,000
1922	324,000	16.50	5,346,000	Bushels	3 75	20,048,000
1921	272,000	13.30	3,618,000	Bushels	2 80	10,130,000
1920	300,000	10.00	3,000,000	Bushels	3 30	9,900,000
1919	472,000	13.90	6,561,000	Bushels	4 35	28,540,000
Hay (tame) 1925	1,780,000	3.04	5,414,000	Tons	14 00	75,796,000
1924	1,990,000	2.33	4,645,000	Tons	21 70	100,797,000
1923	2,066,000	2.55	5,268,000	Tons	14 00	73,752,000
1922	2,108,000	2.47	5,207,000	Tons	15 00	78,105,000
1921	2,129,000	2.35	5,003,000	Tons	11 00	55,033,000
1920	2,150,000	2.30	4,945,000	Tons	20 00	98,900,000
1919	2,150,000	2.25	4,838,000	Tons	17 20	83,214,000
Hay (wild) 1925	148,000	1.40	207,000	Tons	8 50	1,760,000
1924	114,000	0.74	84,000	Tons	17 00	1,428,000
1923	152,000	1.00	152,000	Tons	10 00	1,520,000
1922	160,000	1.10	176,000	Tons	9 00	1,584,000
1921	167,000	1.10	184,000	Tons	7 00	1,288,000
1920	170,000	1.04	177,000	Tons	12 00	2,124,000
1919	178,000	1.04	185,000	Tons	12 00	2,220,000
Potatoes 1925	42,000	155.00	6,510,000	Bushels	2 00	13,020,000
1924	46,000	160.00	7,360,000	Bushels	0 90	6,624,000
1923	52,000	150.00	7,800,000	Bushels	1 12	8,736,000
1922	76,000	130.00	9,880,000	Bushels	0 72	7,114,000
1921	74,000	140.00	10,360,000	Bushels	1 30	13,468,000
1920	70,000	140.00	9,800,000	Bushels	1 50	14,700,000
1919	66,000	130.00	8,580,000	Bushels	1 71	14,672,000

TABLE VI.—*Acreage, Production and Value of Specified Field Crops, 1919-1925.*—Continued.

Crop	Acreage	Production			Farm value, December 1	
		Per acre	Total	Unit	Per unit	Total
Sweet potatoes 1925	9,000	123.00	1,107,000	Bushels	1 70	1,882,000
1924	6,000	113.00	678,000	Bushels	2 18	1,478,000
1923	6,000	115.00	690,000	Bushels	1 65	1,139,000
1922	8,000	110.00	880,000	Bushels	0 67	590,000
1921	8,000	120.00	960,000	Bushels	1 25	1,200,000
1920	8,000	127.00	1,016,000	Bushels	1 60	1,626,000
1919	8,000	130.00	1,040,000	Bushels	1 79	1,862,000
Onions 1925	7,200	303.00	2,183,000	Bushels	1 22	2,668,000
1924	6,190	291.00	1,801,000	Bushels	0 99	1,783,000
1923	8,350	300.00	2,501,000	Bushels	1 15	2,884,000
1922	9,670	271.00	2,624,000	Bushels	0 82	2,146,000
1921	9,900	229.00	2,268,000	Bushels	1 37	3,116,000
1920	11,780	317.00	3,739,000	Bushels	0 77	2,882,000
1919	7,750	368.00	2,852,000	Bushels	1 70	4,854,000
Sugar beets 1925	78,000	6.28	4,901,000	Tons	*7 50	3,675,000
1924	84,000	9.32	783,000	Tons	9 35	7,321,000
1923	61,000	9.59	585,000	Tons	13 57	7,938,000
1922	57,000	7.40	422,000	Tons	10 14	4,279,000
1921	121,000	8.67	1,049,000	Tons	7 51	7,878,000
1920	123,000	8.74	1,075,000	Tons	13 13	14,115,000
1919	107,000	7.61	814,000	Tons	14 17	11,534,000
Hops 1925	5,000	1600.00	8,000,000	Pounds	0 20	1,600,000
1924	6,000	1600.00	9,600,000	Pounds	0 11	1,056,000
1923	5,000	1480.00	7,400,000	Pounds	0 18	1,332,000
1922	9,000	1640.00	14,760,000	Pounds	0 08	1,181,000
1921	12,000	1250.00	15,000,000	Pounds	0 25	3,750,000
1920	12,000	1575.00	18,900,000	Pounds	0 35	6,615,000
1919	9,000	1550.00	13,950,000	Pounds	0 77	10,742,000
**Cotton (lint) 1925	172,000	340.00	58,473,000	Pounds	0 22	12,864,000
1924	129,000	287.00	37,035,000	Pounds	0 24	8,888,000
1923	83,000	313.00	25,990,000	Pounds	0 32	8,317,000
1922	67,000	150.00	10,083,000	Pounds	0 26	2,622,000
1921	55,000	226.00	12,426,000	Pounds	0 18	2,237,000
1920	150,000	212.00	31,874,000	Pounds	0 18	5,737,000
1919	85,000	262.00	22,274,000	Pounds	0 43	9,578,000
**Cotton seed 1925	------------	--------	58,500	Tons	29 50	1,726,000
1924	------------	--------	37,000	Tons	29 00	1,073,000
1923	------------	--------	26,000	Tons	38 00	988,000
1922	------------	--------	10,000	Tons	28 00	280,000
1921	------------	--------	12,000	Tons	13 00	156,000
1920	------------	--------	32,000	Tons	17 00	544,000
1919	------------	--------	22,000	Tons	65 00	1,430,000
Alfalfa seed 1925	x16,000	222.00	3,552,000	Pounds	0 19	675,000
1924	x13,500	252.00	3,402,000	Pounds	0 17	578,000
1923	x11,000	204.00	2,244,000	Pounds	0 16	359,000

*Subject to revision as final price to grower not fully determined at this date.
**Cotton data in this table relate only to that grown within the state.
xIncluded in All Tame Hay acreage.

TABLE VII.—*Estimated Acreage Wheat, Barley and Oats in California, 1923-1925.*

	1923	1924	1925
Wheat—			
Total acreage planted	864,000	782,000	804,000
Acreage harvested for grain	748,000	377,000	603,000
Acreage harvested for hay	85,000	171,000	99,000
Abandoned acreage	31,000	234,000	102,000
Total grain production in tons	484,700	169,700	343,700
Barley—			
Total acreage planted	1,669,000	1,229,000	1,435,000
Acreage harvested for grain	1,095,000	698,000	1,040,000
Acreage harvested for hay	544,000	379,000	334,000
Abandoned acreage	30,000	152,000	61,000
Total grain production in tons	793,700	356,800	773,800
Oats—			
Total acreage planted	407,000	449,000	400,000
Acreage harvested for grain	162,000	86,000	151,000
Acreage harvested for hay	242,000	355,000	241,000
Abandoned acreage	3,000	8,000	8,000
Total grain production in tons	84,200	28,600	83,100

In Table VIII are given estimates of wheat relating to acreage, production and farm price for California and the production for the United States and the world for years 1869 to 1925 inclusive. In Table IX are given the same data relating to barley.

TABLE VIII.—*Wheat Production, California, United States and World, 1869 to 1925.*

Year	California				United States production, 1,000 bushels	Estimated world production, 1,000 bushels
	Acreage harvested	Yield per acre, bushels	Production, bushels	Farm price, cents per bushel		
1869	1,098,901	18.2	20,000,000	93	260,147	-------------
1870	746,052	19.0	14,175,000	110	235,885	-------------
1871	1,523,363	11.0	16,757,000	141	230,722	-------------
1872	2,098,360	12.2	25,600,000	111	249,997	-------------
1873	1,592,889	13.5	21,504,000	132	281,255	-------------
1874	2,150,000	13.2	28,380,000	99	308,103	-------------
1875	2,163,636	11.0	23,800,000	118	292,136	-------------
1876	2,307,692	13.0	30,000,000	114	289,356	-------------
1877	2,315,789	9.5	22,000,000	130	364,194	-------------
1878	2,470,000	17.0	41,990,000	103	420,122	-------------
1879	2,500,000	14.0	35,000,000	123	499,893	-------------
1880	2,117,350	16.0	33,877,600	96	498,550	-------------
1881	2,367,200	12.0	31,406,000	103	383,280	-------------
1882	2,767,000	13.0	36,046,600	90	504,185	-------------
1883	2,794,000	13.0	36,322,000	100	421,086	-------------
1884	3,360,000	13.2	44,320,000	72	512,765	-------------
1885	2,822,400	9.4	26,592,000	67	357,112	-------------
1886	3,104,640	11.6	36,165,000	73	457,218	-------------
1887	2,766,235	11.0	30,429,000	74	456,329	-------------
1888	2,351,300	12.1	28,451,000	85	415,868	-------------
1889	3,291,820	13.3	43,781,000	70	434,383	-------------
1890	2,426,730	12.0	29,121,000	76	378,097	-------------
1891	2,815,007	13.0	36,595,000	95	584,504	-------------
1892	3,012,057	13.0	39,157,000	68	527,987	-------------
1893	2,620,490	13.3	34,852,517	53	427,553	-------------
1894	2,688,204	11.3	30,376,705	57	516,485	2,515,616
1895	3,084,446	13.0	40,097,798	60	569,456	2,440,445
1896	3,088,849	14.6	45,097,195	83	544,193	2,468,629
1897	3,239,402	10.0	32,394,020	83	610,254	2,233,593
1898	1,343,341	9.1	12,224,403	72	772,163	3,012,350
1899	2,393,185	14.1	33,743,908	62	636,051	2,773,061
1900	2,771,226	10.3	28,543,628	58	602,708	2,633,405
1901	2,672,547	13.0	34,743,111	60	788,638	2,900,167
1902	2,052,679	10.9	22,374,201	80	724,808	3,117,721
1903	1,868,410	11.2	20,926,192	87	663,923	3,272,810
1904	1,618,043	10.8	17,474,864	88	596,911	3,144,436
1905	1,886,238	9.3	17,542,013	82	726,819	3,309,345
1906	1,572,144	17.1	26,883,662	75	756,775	3,493,206
1907	1,368,000	15.0	20,520,000	98	637,981	3,189,191
1908	800,000	14.6	11,680,000	102	644,656	3,171,263
1909	426,000	12.5	5,341,000	111	700,434	3,625,128
1910	550,000	18.0	9,900,000	94	635,121	3,575,891
1911	480,000	18.0	8,640,000	88	621,338	3,570,369
1912	370,000	17.0	6,290,000	93	730,267	3,857,488
1913	300,000	14.0	4,200,000	95	763,380	4,087,654
1914	400,000	17.0	6,800,000	104	891,017	3,625,388
1915	440,000	16.0	7,040,000	95	1,025,801	4,166,259
1916	350,000	16.0	5,600,000	152	636,318	3,288,291
1917	375,000	19.8	7,425,000	200	636,655	3,133,838
1918	506,000	15.0	7,590,000	216	921,438	3,147,677
1919	1,087,000	15.5	16,848,000	204	967,979	2,997,051
1920	714,000	14.0	9,996,000	180	833,027	3,033,438
1921	557,000	15.0	8,355,000	107	814,905	3,258,089
1922	712,000	21.5	15,308,000	115	867,598	3,348,099
1923	748,000	21.6	16,157,000	108	797,381	3,742,541
1924	377,000	15.0	5,655,000	154	862,627	*3,098,000
1925	603,000	19.0	11,457,000	148	669,365	-------------

*Exclusive of Russia.

TABLE IX.—*Barley Production, California, United States and World, 1869 to 1925.*

Year	California				United States production, 1,000 bushels	Estimated world production, 1,000 bushels
	Acreage harvested	Yield per acre. bushels	Production, bushels	Farm price, cents per bushel		
1869	348,016	35.3	12,285,000	65	28,652	------
1870	274,275	26.9	7,378,000	98	26,295	------
1871	364,350	20.0	7,287,000	108	26,718	------
1872	603,196	12.2	7,359,000	85	26,846	------
1873	385,433	26.5	10,213,991	85	32,044	------
1874	551,550	20.0	11,031,000	78	32,552	------
1875	502,777	18.0	9,050,000	91	36,909	------
1876	536,363	22.0	11,800,000	69	38,710	------
1877	487,500	16.0	7,800,000	90	35,638	------
1878	650,000	23.0	14,950,000	65	42,246	------
1879	630,500	23.0	14,501,500	56	48,721	------
1880	520,150	28.3	14,720,245	61	45,165	------
1881	537,000	18.9	10,146,000	77	41,161	------
1882	558,480	16.4	9,131,400	67	48,954	------
1883	625,498	16.2	10,135,854	63	50,136	------
1884	688,048	23.6	16,217,000	52	61,203	------
1885	701,809	18.1	12,703,000	79	58,360	------
1886	722,450	22.2	16,038,000	65	59,428	------
1887	794,695	20.5	16,291,000	52	56,812	------
1888	786,748	20.0	15,735,000	58	63,884	------
1889	815,995	21.5	17,548,386	45	78,213	------
1890	677,276	22.3	15,103,255	75	73,017	------
1891	812,731	23.7	19,261,725	61	96,589	------
1892	845,240	24.0	20,285,760	47	92,037	------
1893	760,716	22.5	17,116,110	42	83,700	------
1894	737,895	15.2	11,216,004	45	78,051	1,209,725
1895	937,127	20.3	19,023,678	40	114,732	1,125,471
1896	918,384	21.6	19,837,094	48	99,394	1,127,085
1897	881,649	23.0	20,277,927	54	103,279	1,045,892
1898	872,833	10.5	9,164,746	65	99,922	1,327,512
1899	855,376	26.0	22,239,776	50	116,552	1,143,901
1900	889,591	16.7	14,856,170	43	96,041	1,168,630
1901	1,089,785	26.0	28,334,410	41	121,784	1,222,624
1902	1,144,274	26.0	29,751,124	63	149,389	1,365,344
1903	1,201,488	25.7	30,878,242	61	146,864	1,356,104
1904	1,237,533	22.7	28,091,999	60	162,105	1,313,769
1905	1,237,533	21.5	26,606,960	59	170,089	1,313,903
1906	1,425,000	27.2	38,760,000	54	192,270	1,456,706
1907	1,040,000	28.9	30,056,000	78	170,008	1,438,416
1908	1,082,000	23.5	25,427,000	74	184,857	1,434,561
1909	1,195,000	22.1	26,442,000	74	187,973	1,648,697
1910	1,500,000	31.0	46,500,000	55	173,832	1,518,917
1911	1,450,000	28.0	40,600,000	85	160,240	1,541,983
1912	1,392,000	30.0	41,760,000	70	223,824	1,619,575
1913	1,275,000	26.0	33,150,000	68	178,189	1,778,842
1914	1,402,000	30.0	42,060,000	59	194,953	1,557,233
1915	1,360,000	29.0	39,440,000	62	228,851	1,585,154
1916	1,190,000	28.0	33,320,000	95	182,309	1,514,614
1917	1,350,000	29.0	39,150,000	120	211,759	1,434,642
1918	1,320,000	26.0	34,320,000	115	256,225	1,488,567
1919	987,000	27.0	26,649,000	141	147,608	1,136,303
1920	1,250,000	23.0	28,750,000	100	189,332	1,244,526
1921	1,188,000	25.0	29,700,000	56	154,946	1,276,713
1922	1,129,000	30.5	34,435,000	63	182,068	1,348,202
1923	1,095,000	30.2	33,069,000	70	197,691	1,470,718
1924	698,000	21.3	14,867,000	116	178,322	*1,207,000
1925	1,040,000	31.0	32,240,000	75	218,002	------

*Exclusive of Russia.

Rice—Sacramento Valley continues to produce more than 95 per cent of the total rice grown in the state. Late spring rains somewhat delayed rice planting in 1925. The hot weather which occurred in June and July was very favorable for the crop and irrigation water was ample throughout the year. Cool nights in late August and September retarded development although nearly all rice was mature and harvested before autumn rains occurred.

In Table X are shown rice acreage, production and farm price for California and other important rice producing states and the United States for years 1912 to 1925 inclusive.

TABLE X.—*Rice Production in Principal States and United States, 1912-1925.*

Item and year	South Carolina	Georgia	Florida	Mississippi	Louisiana	Texas	Arkansas	California	United States
Acreage harvested—									
1912	8,000	900	600	2,200	352,600	265,600	90,800	1,400	722,800
1913	4,900	500	400	1,500	405,500	303,000	104,700	6,100	827,100
1914	6,900	1,100	400	1,000	336,500	239,700	92,580	15,000	693,530
1915	3,700	900	500	1,800	401,000	260,000	100,000	34,000	802,600
1916	3,500	800	700	1,900	443,300	235,000	125,000	58,000	869,000
1917	3,000	900	800	2,100	500,000	238,000	152,000	83,000	980,900
1918	4,500	1,200	1,200	3,000	580,000	245,000	170,000	112,000	1,118,550
1919	7,000	4,000	2,000	3,000	527,000	217,000	147,000	155,000	1,063,000
1920	7,000	4,000	3,000	3,000	700,000	281,000	175,000	162,000	1,335,000
1921	7,000	3,000	4,000	1,000	480,000	166,000	125,000	135,000	921,000
1922	8,000	3,000	3,000	1,000	555,000	191,000	154,000	140,000	1,055,000
1923	8,000	3,000	2,000	1,000	495,000	145,000	135,000	106,000	895,000
1924	5,000	3,000	--------	1,000	440,000	146,000	164,000	90,000	849,000
1925	5,000	3,000	--------	1,000	450,000	168,000	174,000	103,000	904,000
Yield per acre, bushels—									
1912	25.0	30.0	25.0	35.0	33.5	35.5	37.5	50.0	34.7
1913	30.0	32.0	25.0	28.0	29.0	32.0	36.0	48.0	31.1
1914	26.0	28.0	25.0	30.0	32.1	33.8	39.8	53.3	34.1
1915	24.3	29.3	25.0	25.0	34.2	30.5	48.4	66.7	36.1
1916	14.0	20.0	25.0	28.0	46.0	45.0	50.5	59.0	47.0
1917	25.0	30.0	26.0	30.0	31.0	30.0	41.0	68.0	35.4
1918	23.0	26.0	24.0	23.0	28.8	32.0	37.9	65.5	34.5
1919	24.0	24.0	26.0	29.0	35.2	32.0	46.0	60.0	39.5
1920	25.0	26.0	24.0	31.0	36.0	34.0	49.0	51.0	39.0
1921	25.0	26.0	22.0	20.0	36.0	36.1	53.5	54.0	40.8
1922	26.0	24.1	25.0	19.0	36.0	31.2	48.0	55.0	39.2
1923	25.0	22.7	23.0	18.0	33.5	40.0	39.5	53.5	37.7
1924	14.0	17.0	--------	10.0	34.6	44.7	42.7	48.5	39.2
1925	16.0	17.0	--------	18.0	33.3	36.0	46.2	46.0	37.6
Production, bushels (in thousands)—									
1912	200	27	15	77	11,812	9,429	3,405	70	25,054
1913	147	16	10	42	11,760	9,696	3,769	293	25,744
1914	179	31	10	30	10,802	8,102	3,685	800	23,649
1915	90	26	12	45	13,714	7,930	4,840	2,268	28,947
1916	49	16	18	53	20,392	10,575	6,312	3,422	40,861
1917	75	27	21	63	15,500	7,140	6,232	5,644	34,739
1918	104	31	29	69	16,704	7,840	6,443	7,336	38,606
1919	168	96	52	87	18,550	6,944	6,762	9,300	41,985
1920	175	104	72	93	25,200	9,554	8,575	8,262	52,035
1921	175	78	88	20	17,280	5,993	6,688	7,290	37,612
1922	208	72	75	19	19,980	5,959	7,392	7,700	41,405
1923	200	68	46	18	16,582	5,800	5,332	5,671	33,717
1924	70	51	--------	10	15,224	6,526	7,003	4,365	33,249
1925	80	51	--------	18	14,985	6,048	8,039	4,738	33,959
Farm price (cents per bushel)..1912	93	90	90	90	93	94	94	91	93.5
1913	90	83	60	70	84	86	90	100	85.8
1914	92	89	70	85	93	92	90	100	92.4
1915	90	88	75	88	90	89	95	90	90.6
1916	90	87	75	80	90	86	96	78	88.9
1917	195	195	195	190	190	200	190	175	189.6
1918	195	175	140	150	195	197	180	190	191.8
1919	300	275	263	190	271	280	240	267	266.6
1920	290	225	175	200	110	125	131	121	119.1
1921	97	92	97	118	86	101	92	115	95.2
1922	115	117	130	110	89	90	88	110	93.1
1923	120	132	135	115	107	115	112	112	110.2
1924	140	140	--------	136	136	125	138	166	138.2
1925	125	145	--------	110	153	149	150	170	153.9

Grain Sorghum—Good yields were secured from grain sorghum in 1925. The average yield per acre of 34 bushels was 3.5 bushels greater than in 1924 and 4.6 bushels above the past seven year average. There are shown in Table XI acreage, production and farm price of grain sorghum in the principal producing states, including California and the United States.

TABLE XI.—*Grain Sorghum in Principal States and United States, 1916-1925.*

Item and year	Nebraska	Kansas	Texas	Oklahoma	Colorado	New Mexico	Arizona	California	United States
Acreage harvested (in thousands)—									
1916	....	1,332	1,200	1,114	70	180	48	....	3,944
1917	....	2,126	1,284	1,400	88	195	60	....	5,153
1918	....	2,139	1,605	1,800	92	166	58	176	6,036
1919	20	977	2,100	1,280	283	158	34	168	5,060
1920	17	1,194	1,906	1,350	282	156	24	150	5,120
1921	15	858	1,950	1,240	237	134	40	140	4,635
1922	19	1,039	1,970	1,450	247	158	30	130	5,064
1923	26	1,598	1,891	1,523	360	205	35	135	5,792
1924	25	1,144	1,300	975	50	135	30	84	3,813
1925	20	1,100	1,625	1,053	50	90	30	88	4,120
Yield per acre, bushels..1916	....	10.0	22.0	7.0	10.0	22.0	35.0	....	13.7
1917	....	8.2	11.5	16.0	15.0	18.0	33.0	....	11.9
1918	....	9.4	15.0	10.0	19.0	18.0	28.0	26.7	12.1
1919	19.0	17.2	33.0	23.0	16.7	25.0	30.0	25.5	25.8
1920	21.0	22.3	32.0	26.0	17.0	24.6	26.0	27.0	26.8
1921	22.0	21.4	29.0	21.0	14.0	25.0	30.0	31.0	24.6
1922	18.0	19.5	20.0	13.5	15.0	11.0	30.0	32.0	17.9
1923	25.6	17.7	22.0	12.0	20.0	18.0	34.0	33.0	18.3
1924	18.0	21.4	22.0	20.0	9.0	20.0	20.0	30.5	21.1
1925	15.0	16.9	19.0	13.5	12.0	20.0	22.0	34.0	17.2
Production, bushels (in thousands)									
1916	....	13,320	26,400	7,798	700	3.960	1,680	....	53,858
1917	....	17,433	14,766	22,400	1,320	3.510	1,980	....	61,409
1918	....	20.107	24,075	18,000	1,748	2,988	1,624	4,699	73,241
1919	380	16,804	69,300	29,440	4,726	3,950	1,020	4,284	130,734
1920	357	26,626	60,992	35,100	4,794	3,838	624	4,050	137,408
1921	330	18,361	56,550	26,040	3,318	3,350	1,200	4,340	113,990
1922	342	20,260	39,400	19,575	3,705	1,738	900	4,160	90,524
1923	666	28,285	41,602	18,276	7,200	3,690	1,190	4,455	105,835
1924	450	24,482	28,600	19,500	450	2,700	600	2,562	80,443
1925	300	18,590	30,875	14,216	600	1,800	660	2,992	71,050
Farm price (cents per bushel)..1916	....	100	110	100	95	110	110	....	105.9
1917	....	155	195	140	180	180	180	....	161.9
1918	....	150	150	150	146	150	170	145	150.0
1919	150	150	110	150	120	130	150	154	127.4
1920	100	69	121	60	84	99	99	105	92.9
1921	40	34	41	30	52	40	60	70	39.1
1922	74	74	100	80	70	80	80	100	87.8
1923	88	82	105	92	90	90	100	100	94.0
1924	91	80	87	77	90	100	130	135	85.2
1925	75	71	76	75	71	65	66	107	75.7

Beans—Due to the drought of 1924 the California total bean crop was then the smallest since statistical records of bean production have been prepared in California. The 1925 crop was far more satisfactory, a total of 4,570,000 bushels being harvested from 240,000 acres. The average yield per acre of 19 bushels exceeded the 1924 yield by 5.5 bushels and the past ten year average by 4.4 bushels.

Table XII shows the estimated acreage and the production in 100-pound bags, segregated by varieties, of all California beans from 1920 to 1925, inclusive. Similar production information by varieties is presented in Table XIII for all important bean states and the United States for 1924 and 1925.

TABLE XII.—*Estimated Bean Production by Varieties, in 100-pound Bags, 1920-1925.*

	1920	1921	1922	1923	1924	1925
Limas	1,100,000	825,000	1,508,000	1,070,000	700,000	1,047,000
Small whites	160,000	120,000	325,000	380,000	85,000	225,000
Large whites	33,000	50,000	105,000	95,000	36,000	30,000
Pinks	200,000	525,000	650,000	675,000	220,000	576,000
Blackeyes	190,000	380,000	250,000	250,000	180,000	495,000
Red kidneys	32,000	50,000	60,000	40,000	21,000	24,000
Cranberries	25,000	40,000	75,000	88,000	58,000	51,000
Mexican reds	30,000	120,000	75,000	80,000	61,000	174,000
Bayos	15,000	45,000	25,000	35,000	17,000	15,000
Miscellaneous	15,000	21,000	27,000	28,000	22,000	30,000
Total production	1,800,000	2,176,000	3,100,000	2,741,000	1,400,000	2,667,000
Harvested acreage	300,000	272,000	324,000	299,000	179,000	240,000

TABLE XIII.—*Bean Production by Varieties in Leading Bean States in Thousands of Bushels, 1924 and 1925.*

Variety	Maine		Vermont		New York		Michigan		Wisconsin	
	1924	1925	1924	1925	1924	1925	1924	1925	1924	1925
Small and medium white	19	18	60	44	564	428	5,416	6,797	76	112
Large white	4	3			[1]282	[1]356	257	331	4	16
Yellow eye	46	47			242	143				
White kidney	10	11			121	86				
Red kidney	13	15			725	356	645	995		
Cranberry										
Mexican red										
Pinto										
Pink										
Lima*										
Blackeye										
Bayo										
Miscellaneous	16	18			81	57	129	166	5	4
Totals	108	112	60	44	2,015	1,426	6,447	8,289	85	132

Variety	Minnesota		Montana		Idaho		Wyoming		Colorado	
	1924	1925	1924	1925	1924	1925	1924	1925	1924	1925
Small and medium white	100	104								
Large white			[2]388	[2]440	[2]951	1,331	[2]82	[2]111		
Yellow eye										
White kidney										
Red kidney										
Cranberry										
Mexican red						15				
Pinto								10	933	2,128
Pink										
Lima*										
Blackeye										
Bayo										
Miscellaneous			20	60	317	238	14	29	19	112
Totals	100	104	408	500	1,268	1,584	96	150	952	2,240

Variety	New Mexico		Arizona		California		Total 13 states	
	1924	1925	1924	1925	1924	1925	1924	1925
Small and medium white					142	375	6,377	7,878
Large white					60	50	2,028	2,638
Yellow eye							288	190
White kidney							131	97
Red kidney					35	40	1,418	1,406
Cranberry					97	85	97	85
Mexican red					102	290	102	305
Pinto	818	375	1	1			1,752	2,514
Pink	17	8	25	34	366	960	408	1,002
Lima*					1,250	1,870	1,250	1,870
Blackeye					300	825	300	825
Bayo					28	25	28	25
Miscellaneous	35	16	4	5	37	50	677	755
Totals	870	399	30	40	2,417	[3]4,570	14,856	[3]19,590

[1] White marrow.
[2] Great Northern.
[3] Revised.
*Includes baby limas.

Hay—Statistical information relative to the California hay crops shown by types for the past two years is recorded in Table XIV. Most of the alfalfa in California is grown by irrigation and had an ample water supply in 1925 which accounts for the very good average yield per acre. A conspicuous decrease in the acreage of grain hay harvested in 1925 will be noted. This condition generally prevails when the average yield per acre is high. Conditions throughout the year were excellent for hay production with the exception of the rainy period in May when the quality of hay that was then in the swath and shock was damaged. In some areas considerable hay was completely ruined at that time. Estimates in this report relative to grain hay are separate and exclusive of all acreage and production data relating to wheat, barley or oats for grain. Table XV includes estimates of acreage and production of alfalfa alone and for all tame hays including alfalfa for all states and the United States for 1924 and 1925.

TABLE XIV.—*Estimated Acreage and Production of California Hay by Types.*

Type	Acreage		Yield per acre in tons		Production—in tons	
	1924	1925	1924	1925	1924	1925
Alfalfa	964,000	971,000	3.75	4.20	3,615,000	4,078,000
Grain hay	905,000	694,000	.90	1.60	815,000	1,110,000
Clover	9,000	9,000	1.56	1.67	14,000	15,000
Timothy	5,000	5,000	1.20	1.60	6,000	8,000
Mixed—clover and timothy	21,000	21,000	1.29	1.71	27,000	36,000
Millet, Sudan grass, etc.	86,000	80,000	1.95	2.09	168,000	167,000
Total—all tame hay	1,990,000	1,780,000	2.33	3.04	4,645,000	5,414,000
Wild hay	114,000	148,000	.74	1.40	84,000	207,000
Total—all hay	2,104,000	1,928,000	2.25	2.92	4,729,000	5,621,000

TABLE XV.—*Tame Hay—Acreage and Production by States in 1924 and 1925.*

Geographical division and state	Alfalfa				Total tame hay (including alfalfa)			
	Acreage (1,000 acres)		Production (1,000 tons)		Acreage (1,000 acres)		Production (1,000 tons)	
	1924	1925	1924	1925	1924	1925	1924	1925
New England.								
Maine	1	1	3	3	1,249	1,249	1,392	1,507
New Hampshire	1	1	3	3	461	461	512	563
Vermont	4	5	11	15	917	920	1,380	1,440
Massachusetts	1	1	3	3	457	457	586	610
Rhode Island	----	----	----	----	47	47	62	63
Connecticut	2	2	6	6	352	355	441	451
Middle Atlantic.								
New York	198	208	515	537	4,953	4,871	7,199	6,730
New Jersey	23	23	63	62	265	265	484	411
Pennsylvania	77	73	177	175	3,087	3,069	4,978	4,274
South Atlantic.								
Delaware	2	2	5	5	85	82	128	112
Maryland	19	19	47	46	426	418	738	570
Virginia	36	40	79	61	1,030	1,005	1,404	768
West Virginia	8	8	20	16	791	785	1,205	950
North Carolina	5	5	14	5	775	789	745	529
South Carolina	3	3	5	2	355	246	166	62
Georgia	3	4	5	2	763	568	392	187
Florida	----	----	----	----	88	78	69	54
East North Central.								
Ohio	152	161	380	370	3,331	3,021	5,303	3,284
Indiana	115	207	264	441	2,375	2,236	3,504	2,264
Illinois	225	248	641	645	3,725	3,503	5,548	3,728
Michigan	350	392	822	804	3,050	3,006	4,758	2,971
Wisconsin	287	310	804	822	3,317	3,362	6,383	5,481
West North Central.								
Minnesota	221	330	597	908	2,299	2,359	3,897	4,132
Iowa	288	279	878	684	3,362	3,152	5,970	4,236
Missouri	189	189	472	463	3,468	3,399	4,829	3,753
North Dakota	116	117	232	263	926	896	1,450	1,452
South Dakota	711	754	1,280	1,078	1,102	1,153	1,819	1,520
Nebraska	1,358	1,300	3,259	3,016	1,963	1,672	4,382	3,635
Kansas	981	990	2,374	2,257	1,570	1,714	3,398	3,466
East South Central.								
Kentucky	54	49	119	110	1,120	1,008	1,587	1,151
Tennessee	15	15	30	22	1,377	1,296	1,435	1,193
Alabama	15	14	22	17	616	591	445	408
Mississippi	18	18	22	28	361	393	340	393
West South Central.								
Louisiana	12	10	15	16	264	242	192	219
Texas	60	71	111	128	828	804	967	653
Oklahoma	240	204	432	306	531	487	845	623
Arkansas	45	43	81	77	588	559	645	445
Mountain.								
Montana	598	604	1,202	1,208	1,206	1,232	2,087	2,034
Wyoming	400	400	800	880	646	663	1,166	1,283
Colorado	873	870	2,008	2,001	1,263	1,245	2,660	2,676
New Mexico	116	116	313	313	174	171	396	387
Arizona	125	128	538	512	158	160	583	555
Utah	467	495	999	1,732	537	568	1,085	1,874
Nevada	145	152	299	547	207	216	363	658
Idaho	731	709	1,828	2,694	1,073	1,032	2,329	3,385
Pacific.								
Washington	260	273	780	819	970	913	1,800	2,057
Oregon	236	226	590	678	953	900	1,394	1,863
California	964	971	3,615	4,078	1,990	1,780	4,645	5,414
United States	10,750	11,040	26,763	28,858	61,451	59,398	98,086	86,474

Potatoes—Potatoes like many other crops in California are produced in certain well defined areas and not grown on nearly every farm as is customary in many agricultural states. In 1925 it was estimated that 42,000 acres were grown of which 14,100 acres were of early potato production while 27,900 acres were harvested as late potatoes. The average yield per acre of 155 bushels gave a total production of 6,510,000 bushels. This yield per acre was five bushels less than the 1924 yield but only exceeded by one other year, namely 1905, when 165 bushels per acre were recorded. About 58 per cent of the total production in 1925 was in the San Joaquin River Delta.

Sweet Potatoes—While the total crop of sweet potatoes in California is not large in comparison to that of many eastern states, it is distinctly important in those areas where commercial production is developed. The four leading counties in order of their importance in the culture of this crop are: Merced, Stanislaus, Orange and Los Angeles. The 1925 crop was satisfactory both from the standpoint of yield and price. Data relative to California production are shown in Table VI.

Sugar Beets—The California sugar beet industry has probably never experienced a more disappointing year than in 1925. There were 100,000 acres of beets originally planted with early conditions favorable. A considerably smaller acreage was thinned than planted while only 78,000 acres were harvested. This large abandonment was due mainly to injury from leafhoppers followed by the Curly Top disease. The average yield per acre was only 6.29 tons which is the lightest yield recorded for many years. However, excessive injuries from these causes have occurred from time to time since 1899. Other production data for recent years are shown in Table VI. Estimates of acreage and production of sugar beets are based on the reports of sugar factories made to the U. S. Department of Agriculture.

The beet sugar produced during recent years in California has been as follows: 1925, 87,000 tons; 1924, 131,000 tons; 1923, 100,000 tons; 1922, 73,000 tons and in 1921, 171,000 tons.

Hops—In California only 5000 acres of hops were worked compared to 6000 acres in 1924. This acreage is less than half of the average annual acreage for the seven-year period prior to 1922, the date of the recent large decline in production.

Table XVI shows the acreage and production for the past three years in the three important hop producing states.

TABLE XVI.—*Estimated Acreage and Production of Hops, 1923-1925.*

	California	Oregon	Washington
Acreage worked in 1925	5,000	13,000	2,350
Acreage worked in 1924	6,000	12,000	2,350
Acreage worked in 1923	5,000	11,550	1,890
Yield per acre in pounds—1925	1,600	1,200	2,116
Yield per acre in pounds—1924	1,600	1,150	1,817
Yield per acre in pounds—1923	1,480	722	2,123
Production in pounds—1925	8,000,000	15,600,000	4,973,000
Production in pounds—1924	9,600,000	13,800,000	4,270,000
Production in pounds—1923	7,400,000	8,339,000	4,012,000

Cotton—The season of 1925 was not the most favorable for cotton in California although the cotton valleys as a whole experienced a gratifying year. Harvested acreage increased 33 per cent over the previous year while the total production increased 58 per cent. The increase in average yield per acre was not wholly due to increased yields in certain localities, but may be partly ascribed to the planting of greater acreages in normally high producing areas with a reduction of acreage in lower producing areas. The average yield per acre for the entire state was 340 pounds fiber which was exceeded only by Arizona with an average yield of 350 pounds. The average yield for the entire United States was 167.2 pounds per acre.

Cotton made an excellent early start in the southern valleys of the state. In the Sacramento and San Joaquin valleys a cool spring delayed early development on the heavier soils. Winds and slight frost damage during the third week in April necessitated some replanting. Considerable cotton was planted late.

Good growing weather prevailed throughout the summer except for two periods of exceedingly high temperatures in late June and July from which some heat damage resulted. Cool nights during September through the two northern valleys tended to retard progress of the crop. Climatic conditions during October were most satisfactory for development and harvest although much of the first picking was delayed by a shortage of labor. Frost throughout the Sacramento and San Joaquin valleys stopped the growth of cotton plants early in November. Following this frost and until well into the winter these valleys experienced unusually damp foggy weather with the result that much cotton did not open properly. The cotton market for low grades was not attractive, which limited the harvest of bolly cotton. The crop in Imperial Valley and Lower California, Mexico, was reduced by ravages of a cotton leaf worm. These insects became very numerous during August and September.

Much interest is evidenced throughout the state relative to the expansion of cotton culture. Tables XVII and XVIII record the acreage and production for the various counties or valleys in which cotton was produced during recent years and should answer many inquiries. Table XIX shows the production in California, United States and the world from 1910 to 1925, inclusive.

TABLE XVII.—*Cotton Acreage and Production in California by Counties, 1923-1925.*

County or valley	Acreage picked			Yield per acre pounds fiber			Production-bales (500-lbs. gross)		
	1923	1924	1925	1923	1924	1925	1923	1924	1925
Sacramento Valley	--------	--------	3,500	------	------	138	--------	--------	1,008
Stanislaus and San Joaquin Counties	--------	--------	1,200	------	------	238	--------	--------	598
Merced County	--------	*400	5,400	------	*305	160	--------	*255	1,812
Madera County	--------	1,400	11,000	------	325	245	--------	952	5,640
Fresno County	**1,500	7,600	17,000	**458	364	369	**1,437	5,787	13,127
Kings County	1,000	6,500	12,000	369	399	421	773	5,426	10,579
Tulare County	700	5,900	17,200	490	437	439	718	5,394	15,808
Kern County	5,800	16,000	32,800	516	532	463	6,261	17,807	31,780
All San Joaquin Valley	9,000	37,800	96,600	488	450	393	9,189	35,621	79,344
Perris Valley	400	800	140	157	105	212	131	176	62
Coachella Valley	4,000	5,500	4,200	397	391	419	3,322	4,496	3,681
Palo Verde Valley	16,800	18,700	19,000	391	276	369	13,743	10,797	14,672
All Riverside County	21,200	25,000	23,340	388	296	377	17,196	15,469	18,415
Imperial Valley, California	47,000	58,400	40,800	243	171	213	23,929	20,873	18,182
Bard Valley	5,800	7,800	7,800	334	338	330	4,059	5,516	5,379
All Imperial County	52,800	66,200	48,600	253	191	232	27,988	26,389	23,561
California total	83,000	129,000	172,000	313	287	340	54,373	77,479	122,328
Imperial Valley (that part in Mexico)	150,000	137,000	150,000	276	247	255	86,478	70,667	80,071
Combined total	233,000	266,000	322,000	289	266	300	140,851	148,146	202,399

*Merced County and north.
**Fresno County and north.

TABLE XVIII.—*Acreage and Production of Cotton in California, 1919-1925.*

Item and year	San Joaquin Valley	Riverside County	Imperial County	Total California	Imperial Valley (that part in Mexico)	Combined total
Acres picked:						
1919	5.500	19.500	60.000	85.000	100,000	185,000
1920	21,000	25.000	104,000	150.000	125.000	275.000
1921	3,500	14.000	37.500	55.000	85.000	140.000
1922	2,500	16.000	48.500	67.000	135.000	202.000
1923	9.000	21,200	52.800	83.000	150,000	233.000
1924	37,800	25,000	66.200	129.000	137.000	266.000
1925	96.600	23,300	48.600	*172,000	150.000	*322,000
Average yield per acre, pounds fiber:						
1919	242	389	222	262	258	260
1920	212	349	180	212	303	254
1921	245	357	175	226	280	259
1922	301	239	113	150	205	187
1923	488	388	253	313	276	289
1924	450	296	191	287	247	266
1925	393	377	232	*340	255	*300
Production, pounds fiber:						
1919	1,332,664	7.593.030	13,348,628	22,274,322	25,812,000	48,086,322
1920	4,446,356	8.726.846	18.701,272	31,874,474	37,857,600	69,732,074
1921	856.098	4,999.880	6.570.036	12,426,014	23,810.614	36,236,628
1922	752,836	3,826.390	5.503.387	10,082,613	27,724,000	37,806,613
1923	4,392,342	8,219.688	13,378,122	25,990,152	41,336,500	67,326,652
1924	17,026,838	7,394,182	12,613,942	37,034,962	33,778,826	70,813,788
1925	37,926,624	8,802,418	11,261,867	*58,472,813	38,273,980	*96,746,793
Production, 500-pound gross bales:						
1919	2.788	15,885	27.926	46.599	54,000	100.599
1920	9.302	18,257	39.124	66.683	79.200	145.883
1921	1.791	10,460	13.745	25,996	49.813	75,809
1922	1,575	8.005	11.513	21,093	58.000	79,093
1923	9.189	17.196	27,988	54,373	86,478	140,851
1924	35.621	15,469	26,389	77,479	70,667	148,146
1925	79,344	18,415	23,561	*122,328	80,071	*202,399

*1925—3.500 acres of cotton were harvested in the Sacramento Valley, with a production of 1,008 bales (500-lb gross), which are included in the totals in the above table.

TABLE XIX.—*Cotton Acreage and Production—California, United States and World, 1910-1925.*

Year	California		United States			Estimated world production in thousands of bales	Average farm price Dec. 1(cents per lb.)	
	Acreage harvested	Production bales	Acreage planted	Acreage harvested	Production bales		California	United States
			000 omitted)					
1910	9,000	6.300	33.418	32.403	11,609	21,915	13.3	14.1
1911	12,000	9,800	36,681	36,045	15.693	25,356	7.5	8.8
1912	9.000	8,500	34.766	34.283	13,703	25,043	12.5	11.9
1913	14,000	14,600	37.458	37.089	14.156	26.259	13.0	12.2
1914	38,000	27,126	37,406	36,832	16,135	28.687	7.0	6.8
1915	12,000	8.741	32.107	31,412	11.192	20.689	11.2	11.3
1916	60,000	41.235	36.052	34,985	11.450	19.845	20.0	19.6
1917	78,000	37,193	34,925	33,841	11.302	19.675	28.0	27.7
1918	78.000	46,908	37.207	36,008	12,041	20.613	30.0	27.6
1919	85,000	46,599	35.133	33.566	11,421	21,384	43.0	35.6
1920	150.000	66.683	37.043	35.878	13.440	20.875	30.0	13.9
1921	55.000	25.996	31.678	30.509	7.954	15.330	17.0	16.2
1922	67.000	21.093	34.016	33,036	9,762	18.900	26.0	23.8
1923	83,000	54.373	38.701	37.123	10.140	19.300	32.0	31.0
1924	129.000	77.479	42.641	41,360	13,628	24.800	24.0	22.6
1925	172.000	122.328	48.090	46.053	16,806	27,800	22.0	18.2

Alfalfa Seed—It is estimated that the alfalfa seed producing localities of California harvested seed from 16.000 acres in 1925; 13.500 acres in

1924 and 11,000 acres in 1923. Full data on this crop are given in Table VI.

Other Miscellaneous Crops—In addition to the crops listed in Tables VI, XX and XXII there are numerous other minor crops that contribute to the agricultural income of the state. Among these may be considered vegetable and flower seeds, mustard seed, sunflower seed, rye, broom corn, etc., as well as avocados, dates, pomegranates, persimmons, various small fruits and other miscellaneous crops. In this report no attempt is made to give production or value of these crops.

FRUIT CROPS.

Apples—A short crop of apples was produced in 1925. The Gravenstein crop was exceptionally light, being only about 25 per cent of normal. Carlot shipments of all apples to May 1, 1926, totaled 2382 cars in comparison with 4828 to the same date last year; however, truck shipments during the past season were heavier than usual. The total shipments for the 1924 crop amounted to 4890 cars. There were 5755 tons of dried apples produced in 1925 compared with 9750 tons in 1924 and 9500 tons in 1923.

Pears—California produced 181,000 tons of pears in 1925, which is 31,000 tons above the production of any previous year. The bearing acreage of pears has increased 113 per cent since 1919. There were 7787 cars of pears shipped from California during the past season compared with 5787 in 1924 and 7187 in 1923. The canners received 60,937 tons in comparison with 38,016 tons the previous year and 31,093 two years ago. The tonnage of dried pears amounted to about 3500 tons in 1925, 3150 tons in 1924 and 2000 tons in 1923.

Peaches—The 1925 production of peaches was about 20,000 tons greater than the average production for the past six years. Conditions throughout the season were quite favorable, although some fruit approaching maturity was injured by the exceedingly high temperatures experienced during July.

Out-of-state shipments amounted to 2960 cars, compared with 1839 in 1924. Canning statistics indicate that about 215,000 tons of Clingstone peaches and 28,000 tons of Freestone peaches were canned. This may be compared with 125,000 tons of Clingstones and 22,000 tons of Freestone peaches canned in 1924. There were about 16,000 tons of dried peaches produced in 1925 which is 8500 tons less than the production of 1924.

Apricots—The 1925 crop of apricots was about an average production. Early season prospects in the Central Coastal counties and in some localities in the Sacramento Valley were reduced by brown rot injury. Interstate shipments totaled 403 cars, while 510 cars were shipped out of the state in 1924. The canneries utilized 43,934 tons in comparison with 41,008 tons canned the year before. About 17,000 tons of dried apricots were produced, which is 1000 tons above the 1924 tonnage.

Prunes—A final check of the 1925 prune crop indicates a total production of about 145,000 tons. The abnormally high temperatures during June and July injured the crop to some extent in the interior valleys. Since 1919 the acreage of bearing prune trees has increased 39 per cent.

Plums—Shipments of plums from California the past season totaled 3709 cars compared with 2887 in 1924 and 5240 in 1923. The volume of plums utilized by the canneries amounted to 2982 tons in 1925, 1511 tons the previous year and 2740 tons two years ago. The acreage of bearing plum trees was 14 per cent greater than in 1924.

Cherries—There were 512 cars of cherries shipped from California in 1925 compared with 710 in 1924 and 581 in 1923. The tonnage handled by the canners amounted to only 3714 tons, which may be compared with 3585 tons the previous year and 9845 tons in 1923. The unusually heavy rains in May were very injurious to the cherries that were mature or practically mature at that time.

Grapes—The total production of fresh grapes of all varieties in California in 1925 was 1,955,000 tons, which were produced on 602,000 acres. Out of this total it was estimated that 1,817,000 tons were harvested and 138,000 tons left on the vines. In 1924 about 1,535,000 tons of fresh grapes were produced on 519,000 acres, practically all of which were harvested.

The total production of raisin grapes on a fresh basis was about 1,136,000 tons, which were produced on 339,000 acres. Carlot shipments of raisin grapes indicated that about 378,000 tons were marketed fresh. It was estimated that 38,000 tons were not harvested and 720,000 tons were dried, producing an equivalent of 180,000 tons of raisins. The quality of raisins produced in 1925 was very good.

In Table XX are given comparative data as to the utilization of the raisin grape crop for previous years.

The total shipments of grapes as reported by the Market News Service, Bureau of Agricultural Economics, amounted to 75,777 cars, of which about 72,700 were shipped outside the state. From conditions as reported during the season and on the basis of about 126,000 acres of table grapes classed as bearing, it was estimated that the total production of table grapes amounted to 424,000 tons of which 324,000 tons were actually harvested. Table grapes on the average did not carry well last year as much of the stock arrived at Eastern markets in poor condition.

Based on 138,000 acres of bearing wine grapes and the condition of the crop it was estimated that the production of grapes of strictly wine varieties amounted to 395,000 tons, all of which were harvested. The quality was not as good as usual as the crop in some localities was affected by gray and black mould.

TABLE XX.—*Production and Value of Specified Fruit Crops, 1919-1925.*

Crop		Production	Unit	Farm value, December 1	
				Per unit	Total
Apples	1925	6,016,000	Bushels	$1 15	$6,918,000
	1924	8,903,000	Bushels	1 22	10,862,000
	1923	10,500,000	Bushels	0 75	7,875,000
	1922	7,850,000	Bushels	0 90	7,065,000
	1921	6,500,000	Bushels	1 35	8,775,000
	1920	6,000,000	Bushels	1 60	9,600,000
	1919	8,200,000	Bushels	1 45	11,890,000
Pears	1925	181,000	Tons	52 00	9,412,000
	1924	133,000	Tons	66 00	8,778,000
	1923	133,000	Tons	50 00	6,650,000
	1922	150,000	Tons	50 00	7,500,000
	1921	86,000	Tons	62 50	5,375,000
	1920	102,000	Tons	90 00	9,180,000
	1919	115,000	Tons	72 00	8,280,000
Peaches	1925	390,000	Tons	37 00	14,430,000
	1924	330,000	Tons	35 00	11,550,000
	1923	380,000	Tons	24 00	9,120,000
	1922	410,000	Tons	45 00	18,450,000
	1921	310,000	Tons	42 00	13,020,000
	1920	360,000	Tons	76 00	27,360,000
	1919	430,000	Tons	60 00	25,800,000
Apricots	1925	150,000	Tons	54 00	7,560,000
	1924	142,000	Tons	46 00	6,532,000
	1923	210,000	Tons	25 00	5,250,000
	1922	145,000	Tons	70 00	10,150,000
	1921	100,000	Tons	50 00	5,000,000
	1920	110,000	Tons	85 00	9,350,000
	1919	175,000	Tons	80 00	14,000,000
Prunes	1925	145,000	Tons	110 00	15,950,000
	1924	139,000	Tons	110 00	15,290,000
	1923	130,000	Tons	100 00	13,000,000
	1922	110,000	Tons	140 00	15,400,000
	1921	100,000	Tons	130 00	13,000,000
	1920	97,250	Tons	130 00	12,643,000
	1919	135,000	Tons	240 00	32,400,000
Plums	1925	51,000	Tons	45 00	2,295,000
	1924	39,000	Tons	45 00	1,755,000
	1923	69,000	Tons	30 00	2,070,000
	1922	48,000	Tons	50 00	2,400,000
	1921	42,000	Tons	53 00	2,226,000
	1920	35,000	Tons	90 00	3,150,000
	1919	42,000	Tons	60 00	2,520,000
Cherries	1925	11,000	Tons	160 00	1,760,000
	1924	13,500	Tons	140 00	1,890,000
	1923	17,000	Tons	160 00	2,720,000
	1922	14,000	Tons	180 00	2,520,000
	1921	13,000	Tons	125 00	1,625,000
	1920	17,500	Tons	200 00	3,500,000
	1919	12,400	Tons	150 00	1,860,000
Raisins—dried	1925	180,000	Tons	80 00	14,400,000
	1924	170,000	Tons	70 00	11,900,000
	1923	290,000	Tons	70 00	20,300,000
	1922	237,000	Tons	105 00	24,885,000
	1921	145,000	Tons	190 00	27,550,000
	1920	177,000	Tons	235 00	41,595,000
	1919	182,500	Tons	210 00	38,325,000
*Raisin grapes—marketed fresh	1925	378,000	Tons	25 00	9,450,000
	1924	180,000	Tons	20 00	3,600,000
	1923	130,000	Tons	20 00	2,600,000
	1922	95,000	Tons	30 00	2,850,000
	1921	47,000	Tons	40 00	1,880,000
	1920	24,000	Tons	40 00	960,000
	1919	----------------	--------	----------	--------------

*It was estimated that 38,000 tons of raisin grapes on a fresh basis were not harvested and have not been included in the above estimates.

TABLE XX.—*Production and Value of Specified Fruit Crops, 1919-1925*—Continued.

Crop		Production	Unit	Farm value, December 1	
				Per unit	Total
*Grapes—table	1925	324,000	Tons	$24 00	$7,776,000
	1924	325,000	Tons	40 00	13,000,000
	1923	312,000	Tons	40 00	12,480,000
	1922	213,000	Tons	60 00	12,780,000
	1921	163,000	Tons	80 00	13,040,000
	1920	166,000	Tons	75 00	12,450,000
	1919	200,000	Tons	75 00	15,000,000
Grapes—wine	1925	395,000	Tons	58 00	22,910,000
	1924	350,000	Tons	63 00	22,050,000
	1923	428,000	Tons	40 00	17,120,000
	1922	450,000	Tons	65 00	29,250,000
	1921	310,000	Tons	82 00	25,420,000
	1920	375,000	Tons	75 00	28,125,000
	1919	400,000	Tons	50 00	20,000,000
Oranges	1925	24,000,000	Boxes	3 30	79,200,000
	1924	18,487,000	Boxes	3 55	65,629,000
	1923	24,500,000	Boxes	2 00	49,000,000
	1922	20,500,000	Boxes	2 00	41,000,000
	1921	13,000,000	Boxes	2 80	36,400,000
	1920	21,600,000	Boxes	2 18	47,088,000
	1919	15,528,000	Boxes	2 75	42,702,000
Lemons	1925	6,000,000	Boxes	3 00	18,000,000
	1924	5,125,000	Boxes	3 48	17,835,000
	1923	6,732,000	Boxes	1 60	10,771,000
	1922	3,400,000	Boxes	3 30	11,220,000
	1921	4,050,000	Boxes	3 45	13,973,000
	1920	4,955,000	Boxes	2 92	14,469,000
	1919	3,499,000	Boxes	2 00	6,998,000
Figs	1925	9,500	Tons	110 00	1,045,000
	1924	8,500	Tons	100 00	850,000
	1923	9,500	Tons	90 00	855,000
	1922	11,000	Tons	120 00	1,320,000
	1921	9,600	Tons	145 00	1,392,000
	1920	12,300	Tons	90 00	1,107,000
	1919	12,000	Tons	150 00	1,800,000
Olives	1925	14,000	Tons	60 00	840,000
	1924	6,500	Tons	92 00	598,000
	1923	17,000	Tons	65 00	1,105,000
	1922	10,000	Tons	125 00	1,250,000
	1921	8,200	Tons	90 00	738,000
	1920	8,000	Tons	95 00	760,000
	1919	8,800	Tons	160 00	1,408,000
Almonds	1925	7,500	Tons	400 00	3,000,000
	1924	8,000	Tons	300 00	2,400,000
	1923	11,000	Tons	260 00	2,860,000
	1922	8,500	Tons	290 00	2,465,000
	1921	6,000	Tons	320 00	1,920,000
	1920	5,500	Tons	360 00	1,980,000
	1919	7,250	Tons	440 00	3,190,000
Walnuts	1925	31,500	Tons	440 00	13,420,000
	1924	22,500	Tons	460 00	10,350,000
	1923	25,000	Tons	400 00	10,000,000
	1922	27,000	Tons	360 00	9,720,000
	1921	19,500	Tons	400 00	7,800,000
	1920	21,000	Tons	400 00	8,400,000
	1919	28,100	Tons	550 00	15,455,000

*It was estimated that 100,000 tons of table grapes were not harvested and have not been included in the above estimates.

Oranges—A final check on shipments of oranges for the 1924-25 crop, plus the tonnage consigned to by-product factories and otherwise utilized, shows a total production of about 18,100,000 boxes. Grapefruit production was estimated at 387,000 boxes. In Table XX orange and grapefruit production is given under the caption of "oranges" that comparative data may be shown for 1919-1925, inclusive. The 1925-26 crop escaped all frost injury and promises high production and good quality. A revised estimate as of May 1 places the crop of oranges and grapefruit at 24,000,000 boxes.

Lemons—A revised estimate of the 1924-25 lemon crop shows that about 5,125,000 boxes of lemons were picked and sent to market. Of this total about 4,492,611 boxes were moved in carlots. Production for the 1925-26 crop is given in Table XX.

Olives—Data collected from various sources would indicate that about 6000 tons of olives of the 1925 crop were utilized for pickling and 4500 tons in the production of oil. The balance of the crop, about 3500 tons, was shipped fresh, home-pickled, salt-cured and otherwise utilized.

Almonds—Regardless of an 11 per cent increase in the bearing acreage, the 1925 crop was 500 tons under the 1924 production. Almond trees in some localities produced very good crops but in most sections the yields were unusually light.

Walnuts—California produced its largest crop of walnuts in 1925. The quality of the nuts was not up to the average and a much larger tonnage than usual was diverted to the cracking plants. The estimate of production shown in Table XX is for the total crop produced and when a final check is made of the tonnage of cracked nuts a further revision upward of the production in 1925 may be necessary. The reader's attention is directed to the rapid increase in the bearing acreage of walnuts the past few years as shown in Table XXV.

* * *

VEGETABLE CROPS.

California continues to be the foremost state in the production of vegetables. In Table I are included estimates of total acreage and value of all vegetable crops in California from 1919 to 1925, inclusive. Tables XXI and XXII show the acreage and value of specified commercial vegetable crops for 1921 to 1925, inclusive. Other vegetables of less gross importance have been grouped under the heading, "All Other Vegetables." Onions, potatoes and sweet potatoes are classed as field crops in this report. A record of carlot shipments of various vegetables shipped out of California for each of the past five years is given in Table XXIII.

TABLE XXI.—*Acreage of Specified Vegetable Crops, 1921-1925.*

	1921	1922	1923	1924	1925
Asparagus	20,990	21,540	28,580	31,760	34,400
Beans, green (canning)	370	890	1,060	620	700
Beans, green (table)	2,260	2,180	1,980	2,000	2,000
Cabbage	7,320	7,320	5,300	5,670	6,000
*Cantaloupes (Imperial Valley)	21,350	31,330	26,100	30,200	27,560
*Cantaloupes (Other districts)	4,310	7,380	6,770	7,460	10,120
Cauliflower	6,190	6,700	7,260	6,550	6,610
Celery	4,520	6,480	6,170	6,330	5,890
Cucumbers	2,440	1,940	2,480	2,570	3,210
Lettuce (Imperial Valley)	7,000	11,000	14,130	18,000	25,000
Lettuce (Other districts)	8,340	7,140	10,570	15,020	24,320
Peas, green (canning)	2,360	3,970	4,410	5,260	5,270
Peas, green (table)	5,760	7,910	9,820	4,390	4,940
Spinach (canning)	5,320	5,660	8,290	8,290	9,690
Spinach (table)	740	1,330	1,420	2,070	1,710
Tomatoes (canning)	6,860	24,140	30,760	26,000	29,000
Tomatoes (table)	6,860	7,170	13,100	11,740	11,880
Watermelons (Imperial Val.)	3,000	4,300	3,400	3,800	4,000
Watermelons (Other districts)	6,040	6,220	5,080	5,070	5,530
†All other vegetables	23,000	26,000	27,000	28,000	30,000
Totals	145,030	190,600	213,680	220,800	247,830

*Includes cantaloupes, casabas, Persians and honey dews.
†Includes artichokes, peppers, carrots, beets, radishes, pumpkins, squash, turnips, etc.

TABLE XXII.—*Value of Specified Vegetable Crops, 1921-1925.*

	1921	1922	1923	1924	1925
Asparagus	$3,012,000	$6,661,000	$11,957,000	$8,799,000	$7,698,000
Beans, green (canning)	80,000	250,000	247,000	106,000	112,000
Beans, green (table)	1,246,000	1,100,000	2,697,000	472,000	752,000
Cabbage	709,000	1,156,000	1,581,000	1,361,000	788,000
*Cantaloupes (Imperial Val.)	6,021,000	15,833,000	10,794,000	8,377,000	8,682,000
*Cantaloupes (Other districts)	605,000	790,000	2,365,000	1,253,000	1,190,000
Cauliflower	1,659,000	3,960,000	2,736,000	1,430,000	2,320,000
Celery	2,375,000	3,579,000	2,250,000	2,065,000	2,270,000
Cucumbers	342,000	297,000	325,000	368,000	535,000
Lettuce (Imperial Valley)	1,889,000	3,548,000	3,973,000	5,828,000	8,700,000
Lettuce (Other districts)	2,968,000	2,873,000	4,039,000	4,009,000	4,434,000
Peas, green (canning)	98,000	389,000	196,000	259,000	236,000
Peas, green (table)	1,165,000	1,298,000	1,931,000	516,000	568,000
Spinach (canning)	471,000	575,000	979,000	729,000	512,000
Spinach (table)	436,000	543,000	362,000	571,000	239,000
Tomatoes (canning)	465,000	2,483,000	2,775,000	2,496,000	2,834,000
Tomatoes (table)	3,405,000	5,536,000	9,863,000	3,481,000	4,844,000
Watermelons (Imperial Val.)	413,000	418,000	979,000	561,000	612,000
Watermelons (Other districts)	577,000	481,000	534,000	383,000	221,000
†All other vegetables	3,200,000	3,400,000	2,800,000	4,000,000	4,500,000
Totals	31,136,000	55,170,000	63,383,000	47,064,000	52,047,000

*Includes cantaloupes, casabas, Persians and honey dews.
†Includes artichokes, peppers, carrots, beets, radishes, pumpkins, squash, turnips, etc.

TABLE XXIII.—*Carlot Shipments of Vegetables from California, 1921-1925.*

	1921	1922	1923	1924	1925
Asparagus	362	304	458	718	1,296
Beans, green	60	20	26	38	66
Cabbage	882	738	683	369	648
*Cantaloupes (Imperial Val.)	10,659	12,243	12,992	16,045	14,509
*Cantaloupes (Other districts)	2,507	3,061	3,487	3,999	4,374
Carrots	18	22	27	166	334
Cauliflower	3,157	3,157	3,575	3,241	3,761
Celery	3,460	3,474	4,527	4,522	5,340
Cucumbers	89	68	125	23	125
Lettuce (Imperial Valley)	3,669	4,806	7,994	9,297	9,861
Lettuce (Other districts)	6,181	4,938	7,119	9,183	11,528
Peppers	18	59	20	81	69
Spinach	51	303	455	94	303
Tomatoes	1,819	2,346	3,296	2,786	2,629
Watermelons	3,773	4,302	4,054	4,363	4,533
Mixed vegetables	4,181	3,737	4,337	4,329	4,753
Totals	40,886	43,578	53,175	59,254	64,129

*Includes cantaloupes, casabas, Persians and honey dews.

NOTE.—Shipments are for the calendar year and not the crop year.

ESTIMATES OF CALIFORNIA FRUIT ACREAGES.

Acreage estimates of the principal fruit crops grown in California are given in Tables XXVII to XXXIV, inclusive. The acreages for each fruit are segregated as to bearing and nonbearing relative to each county and the state as a whole. The 1925 plantings of tree fruits are not included in the county totals of nonbearing acreage but are given in footnotes on each page. The different varieties of grapes have been arbitrarily arranged by classes in accordance with their general use rather than by considering the methods of disposal during recent years.

The acreage data have been compiled from reports of the County Horticultural Commissioners and checked with figures of the Bureau of the Census and all other available information.

A number of revisions were found necessary following the quinquennial Census of Agriculture taken in January, 1925, and also more recent surveys made in a number of counties by the Commissioners of Horticulture. These acreage data include only the commercial plantings and are believed to be more nearly correct than any that have been published heretofore.

In Table XXV is shown the estimated bearing acreage of tree fruits in California, 1914 to 1926, inclusive, and the bearing acreage of grapes by classes, 1919 to 1926, inclusive.

The estimated acreage of Clingstone and Freestone peaches separately, for 1926 by counties, with the plantings for each class in 1925, is given in Table XXXV. A survey was recently completed of the acreage of peaches in California by age and variety. The result of this survey for the state is given in Table XXXVI, while in Tables XXXVII, XXXVIII and XXXIX is shown the estimated acreage of peaches by age and variety for Northern, Central and Southern California.

TABLE XXIV.—*Summary of California Tree Fruit and Grape Acreage Report, 1926.*

	Total bearing acreage	Total nonbearing acreage	Nonbearing acreage exclusive of 1925 plantings	1925 plantings	Grand total acreage
Apples	55,637	14,370	13,131	1,239	70,007
Peaches (clingstone)	66,715	31,873	26,339	5,534	98,588
Peaches (freestone)	64,772	14,422	11,889	2,533	79,194
Pears	55,523	36,172	29,198	6,974	91,695
Apricots	77,512	26,330	23,717	2,613	103,842
Plums	30,171	11,445	9,675	1,770	41,616
Prunes	160,512	37,487	31,660	5,827	197,999
Cherries	11,624	5,621	4,271	1,350	17,245
Figs	35,139	25,954	24,490	1,464	61,093
Olives	26,772	5,545	5,188	357	32,317
Grapefruit	5,682	3,501	3,386	115	9,183
Lemons	44,798	2,407	2,165	242	47,205
Oranges	183,859	13,648	11,143	2,505	197,507
Almonds	75,311	27,026	25,844	1,182	102,337
Walnuts	72,593	43,079	35,166	7,913	115,672
Totals (tree fruits)	966,620	298,880	257,262	41,618	1,265,500
Wine grapes	156,945	17,429	9,062	8,367	174,374
Table grapes	144,200	7,393	5,366	2,027	151,593
Raisin grapes	352,091	2,737	2,009	728	354,828
Totals (grapes)	653,236	27,559	16,437	11,122	680,795
Grand totals (fruits and grapes)	1,619,856	326,439	273,699	52,740	1,946,295

TABLE XXV.—*Estimated Bearing Acreage of Tree Fruits in California, 1914 to 1926, Inclusive.*
Estimated Bearing Acreage of Grapes in California, 1919 to 1926, Inclusive.

	1914	1915	1916	1917	1918	1919	1920
Apples	37,839	39,210	39,602	41,584	43,647	46,731	46,931
Peaches	115,028	114,175	114,034	113,918	107,575	103,378	103,200
Pears	16,246	18,029	18,039	20,228	22,416	23,056	29,366
Apricots	34,350	40,918	40,471	40,024	40,886	46,100	47,907
Plums	16,069	16,460	17,436	17,360	17,284	17,250	17,300
Prunes	82,933	91,470	101,190	102,278	103,000	104,000	105,000
Cherries	8,200	8,269	8,240	8,428	8,616	8,750	8,884
Figs	5,857	5,709	5,970	6,022	8,761	10,500	11,023
Olives	13,204	16,054	17,114	17,958	18,801	19,165	19,528
Grapefruit	766	916	1,200	1,600	2,000	2,568	3,109
Lemons	18,960	20,453	21,946	22,651	26,744	36,060	40,937
Oranges	107,281	112,926	113,729	123,821	130,971	145,000	162,000
Almonds	14,947	18,602	20,470	28,383	29,242	30,100	35,044
Walnuts	34,138	34,453	35,379	45,687	48,520	50,900	58,963
Totals (all fruits)	505,818	537,644	554,820	589,942	608,463	643,558	689,192
Wine grapes	--------	--------	--------	--------	--------	97,000	100,000
Table grapes	--------	--------	--------	--------	--------	55,000	57,000
Raisin grapes	--------	--------	--------	--------	--------	170,000	189,000
Totals (grapes)	--------	--------	--------	--------	--------	322,000	346,000
Grand totals (fruits and grapes)	--------	--------	--------	--------	--------	965,558	1,035,192

	1921	1922	1923	1924	1925	1926
Apples	47,130	49,354	50,850	52,061	54,084	55,637
Peaches	100,713	105,557	107,692	111,131	119,891	131,487
Pears	31,808	38,741	42,031	44,862	49,171	55,523
Apricots	58,369	62,875	64,493	66,479	71,268	77,512
Plums	19,715	22,434	23,800	25,398	29,055	30,171
Prunes	108,185	118,169	126,145	135,800	144,611	160,512
Cherries	9,082	9,829	10,158	10,493	11,045	11,624
Figs	11,472	14,840	19,160	23,524	26,544	35,139
Olives	23,050	24,501	24,979	25,517	26,107	26,772
Grapefruit	3,642	3,935	4,067	4,205	4,969	5,682
Lemons	42,266	42,528	43,021	43,215	44,270	44,798
Oranges	171,928	175,415	176,320	177,478	180,341	183,859
Almonds	42,564	52,876	58,472	62,313	69,371	75,311
Walnuts	61,781	65,530	66,951	68,572	69,629	72,593
Totals (all fruits)	731,705	786,584	818,139	851,048	900,356	966,620
Wine grapes	105,000	110,000	113,198	121,691	137,749	156,945
Table grapes	60,000	65,000	77,389	97,162	125,623	144,200
Raisin grapes	197,000	232,000	243,510	299,655	338,790	352,091
Totals (grapes)	362,000	407,000	434,097	518,508	602,162	653,236
Grand totals (fruits and grapes)	1,093,705	1,193,584	1,252,236	1,369,556	1,502,518	1,619,856

In Table XXVI is given a forecast of the bearing acreage of tree fruits for 1927, 1928 and 1929 and also a forecast of the bearing acreage of grapes for 1927 and 1928 in comparison with the estimated bearing acreage of tree fruits and grapes for 1926. This forecast of future bearing acreages is based upon an estimate of recent plantings that under normal conditions should come into bearing during the next three years. An allowance also has been made for the acreage that may be taken out as being no longer profitable.

TABLE XXVI.—*Forecast of Bearing Acreage of Tree Fruits, 1927, 1928 and 1929; and Grapes 1927 and 1928.*

	Estimated 1926	Forecast 1927	Forecast 1928	Forecast 1929
Apples	55,637	57,200	59,000	60,500
Peaches (clingstone)	66,715	84,000	89,500	93,500
Peaches (freestone)	64,772	70,200	70,200	69,500
Pears	55,523	60,600	67,300	75,100
Apricots	77,512	81,800	92,300	94,500
Plums	30,171	33,700	37,700	39,600
Prunes	160,512	168,500	176,500	180,300
Cherries	11,624	12,400	12,800	13,700
Figs	35,139	43,500	48,100	54,600
Olives	26,772	27,200	27,700	27,700
Grapefruit	5,682	5,700	6,100	7,100
Lemons	44,798	44,600	44,500	44,500
Oranges	183,859	188,200	188,000	188,000
Almonds	75,311	82,800	88,000	92,400
Walnuts	72,593	76,200	79,800	86,000
Totals (all tree fruits)	966,620	1,036,600	1,087,500	1,127,000
Wine grapes	156,945	164,000	170,300	------------
Table grapes	144,200	147,900	148,300	------------
Raisin grapes	352,091	349,000	344,600	------------
Totals (grapes)	653,236	660,900	663,200	------------
Grand totals	1,619,856	1,697,500	1,750,700	------------

TABLE XXVII.—*Estimated Acreage of Apples, Peaches and Pears by Counties, 1926.*

	Apples		All peaches		Pears	
	Bearing	*Non-bearing	Bearing	*Non-bearing	Bearing	*Non-bearing
The State	55,637	13,131	131,487	38,228	55,523	29,198
District No. 1.						
Del Norte	----------	----------	----------	----------	4	----------
Humboldt	833	59	90	9	262	78
Mendocino	1,212	253	151	62	1,270	2,080
District No. 2						
Shasta	270	30	500	30	125	35
Siskiyou	950	199	30	9	25	18
Trinity	53	----------	----------	----------	12	----------
District No. 3.						
Lassen	96	----------	29	----------	4	----------
Modoc	350	15	11	----------	12	----------
Plumas	32	----------	----------	----------	2	----------
District No. 4.						
Alameda	143	44	150	200	1,148	435
Contra Costa	330	259	876	613	3,207	1,088
Lake	256	39	50	55	3,423	3,699
Marin	70	25	38	10	160	75
Monterey	3,601	325	205	----------	821	1,445
Napa	400	319	100	5	1,500	2,000
San Benito	190	22	524	129	673	315
San Luis Obispo	800	300	900	150	1,800	575
San Mateo	310	62	90	71	225	305
Santa Clara	1,096	180	2,472	568	4,060	1,828
Santa Cruz	15,300	300	125	100	700	700
Sonoma	9,450	7,850	325	230	1,550	950
District No. 5.						
Butte	528	123	2,694	1,210	583	153
Colusa	25	----------	51	738	36	43
Glenn	68	2	408	1,051	449	104
Sacramento	250	75	2,775	965	6,400	3,900
Solano	70	73	2,954	271	3,455	503
Sutter	97	5	11,101	6,043	572	219
Tehama	138	27	1,639	487	212	120
Yolo	63	9	2,264	315	1,400	1,211
Yuba	30	15	1,430	1,922	775	195
District No. 5a.						
Fresno	1,225	25	17,072	428	230	10
Kern	1,344	12	301	599	1,175	4
Kings	38	----------	4,200	1,250	10	40
Madera	142	----------	2,892	726	4	4
Merced	91	28	11,774	5,661	174	74
San Joaquin	60	16	6,072	1,575	2,729	623
Stanislaus	93	3	10,136	2,508	222	128
Tulare	1,512	431	12,559	7,330	540	619
District No. 6.						
Alpine	----------	----------	----------	----------	1	----------
Amador	120	12	183	1	72	2
Calaveras	174	10	74	----------	60	3
El Dorado	450	113	500	25	2,300	920
Inyo	1,052	180	75	10	50	405
Mariposa	170	11	24	----------	8	----------
Mono	51	----------	2	----------	19	----------
Nevada	300	----------	175	----------	1,370	----------
Placer	486	11	8,400	895	3,726	1,374
Sierra	18	----------	----------	----------	1	----------
Tuolumne	1,200	600	124	10	125	15
District No. 8.						
Imperial	----------	----------	----------	----------	70	10
Los Angeles	1,054	151	7,262	602	4,519	1,432
Orange	280	320	20	10	57	16
Riverside	1,940	49	6,163	378	1,114	827
San Bernardino	5,840	144	9,735	569	1,436	272
San Diego	537	227	1,428	320	518	146
Santa Barbara	180	77	250	33	50	26
Ventura	269	101	84	55	78	174

*1925 plantings not included.
Estimated acreage planted in state, 1925: Apples, 1,239; peaches, 8,067; pears, 6,974.

TABLE XXVIII.—*Estimated Acreage of Apricots, Plums and Prunes by Counties, 1926.*

	Apricots		Plums		Prunes	
	Bearing	*Non-bearing	Bearing	*Non-bearing	Bearing	*Non-bearing
The State	77,512	23,717	30,171	9,675	160,512	31,660
District No. 1.						
Humboldt	50	-----	135	-----	-----	-----
Mendocino	48	-----	17	5	1,190	581
District No. 2						
Shasta	25	15	150	3	900	300
Siskiyou	7	-----	10	-----	40	3
Trinity	-----	-----	7	-----	7	-----
District No. 3.						
Lassen	14	-----	10	-----	-----	-----
Modoc	-----	-----	13	-----	-----	-----
District No. 4.						
Alameda	5,219	1,000	200	100	1,700	500
Contra Costa	800	1,143	25	55	1,052	578
Lake	42	27	-----	4	1,627	1,142
Marin	50	8	9	-----	55	45
Monterey	1,280	400	45	-----	154	200
Napa	30	115	100	50	7,900	3,675
San Benito	4,533	660	20	-----	3,966	1,085
San Luis Obispo	913	475	105	188	2,600	1,000
San Mateo	139	111	22	76	247	15
Santa Clara	15,840	2,256	1,400	100	62,296	4,245
Santa Cruz	1,900	200	-----	-----	1,498	120
Sonoma	55	20	550	300	15,275	5,450
District No. 5.						
Butte	112	14	289	32	8,237	1,083
Colusa	242	600	23	-----	2,759	2,090
Glenn	216	1,156	15	12	3,085	1,289
Sacramento	300	450	2,800	1,000	2,500	800
Solano	3,541	312	4,270	432	8,662	409
Sutter	93	49	246	255	5,957	1,464
Tehama	493	195	26	34	3,064	505
Yolo	2,000	525	1,175	625	1,733	559
Yuba	80	91	50	90	1,257	466
District No. 5a.						
Fresno	3,225	400	3,000	500	2,584	200
Kern	712	1,170	203	857	417	131
Kings	3,250	700	110	100	1,150	500
Madera	633	1,231	171	435	74	86
Merced	1,136	1,264	203	109	329	124
San Joaquin	1,046	153	1,601	200	1,849	300
Stanislaus	4,130	1,303	133	19	391	137
Tulare	2,493	1,631	3,387	2,457	14,457	2,319
District No. 6.						
Amador	9	-----	225	5	93	-----
Calaveras	23	-----	17	-----	56	8
El Dorado	-----	-----	500	130	-----	-----
Inyo	1	1	16	4	26	-----
Mariposa	-----	-----	27	-----	10	-----
Nevada	-----	-----	265	3	-----	-----
Placer	154	29	7,465	1,267	-----	-----
Tuolumne	1	-----	5	1	13	-----
District No. 8.						
Imperial	-----	-----	-----	-----	-----	-----
Los Angeles	4,231	1,227	611	117	71	17
Orange	81	3	-----	-----	-----	-----
Riverside	5,995	1,471	23	-----	656	63
San Bernardino	2,519	119	186	26	66	-----
San Diego	706	158	275	75	325	125
Santa Barbara	290	208	20	2	-----	16
Ventura	8,855	2,827	16	7	184	30

*1925 plantings not included.

Estimated acreage planted in state, 1925: Apricots, 2,613; plums, 1,770; prunes, 5,827.

TABLE XXIX.—*Estimated Acreage of Cherries, Figs and Olives by Counties, 1926.*

	Cherries		Figs		Olives	
	Bearing	*Non-bearing	Bearing	*Non-bearing	Bearing	*Non-bearing
The State	11,624	4,271	35,139	24,490	26,772	5,188
District No. 1.						
Humboldt	50	10	----------	----------	----------	----------
Mendocino	63	36	10	----------	----------	----------
District No. 2						
Shasta	30	7	30	10	300	900
Siskiyou	14	20	----------	----------	----------	----------
District No. 3.						
Lassen	7	----------	----------	----------	----------	----------
Modoc	27	----------	----------	----------	----------	----------
District No. 4.						
Alameda	800	400	17	----------	----------	----------
Contra Costa	212	100	52	193	150	2
Lake	11	7	11	9	25	8
Marin	12	2	----------	----------	5	15
Monterey	18	----------	6	----------	5	----------
Napa	425	75	11	----------	----------	----------
San Benito	26	36	----------	----------	----------	----------
San Luis Obispo	43	45	36	26	9	----------
San Mateo	25	38	6	17	122	7
Santa Clara	2,676	392	40	----------	50	----------
Santa Cruz	340	45	----------	----------	----------	----------
Sonoma	1,000	500	25	5	160	33
District No. 5.						
Butte	58	37	223	145	3,410	965
Colusa	----------	20	----------	75	10	----------
Glenn	8	3	485	437	585	36
Sacramento	300	250	125	80	3,721	861
Solano	1,000	133	188	35	38	8
Sutter	224	154	159	1	80	6
Tehama	25	104	103	54	616	297
Yolo	84	31	481	570	217	164
Yuba	50	41	380	773	340	47
District No. 5a.						
Fresno	100	10	14,180	6,232	1,200	361
Kern	15	11	324	144	813	1
Kings	----------	40	30	30	260	----------
Madera	----------	----------	1,214	1,635	690	1
Merced	8	25	7,205	6,182	250	32
San Joaquin	1,912	836	841	3,859	651	25
Stanislaus	100	40	2,206	843	398	38
Tulare	125	96	5,897	2,358	5,504	857
District No. 6.						
Amador	11	2	----------	----------	----------	----------
Calaveras	6	----------	13	----------	103	30
El Dorado	120	126	9	----------	5	----------
Inyo	8	5	----------	----------	----------	----------
Mariposa	----------	----------	30	----------	----------	----------
Nevada	60	----------	20	----------	----------	----------
Placer	549	124	64	4	352	26
Tuolumne	1	----------	80	2	----------	----------
District No. 8.						
Imperial	----------	----------	60	----------	80	----------
Los Angeles	14	12	143	480	1,670	2
Orange	----------	----------	92	15	61	----------
Riverside	407	229	32	87	1,371	390
San Bernardino	434	187	63	23	1,234	48
San Diego	163	23	236	132	1,500	28
Santa Barbara	35	17	6	11	375	----------
Ventura	28	2	6	23	412	----------

*1925 plantings not included.
Estimated acreage planted in state, 1925: Cherries, 1,350; figs, 1,464; olives, 357.

TABLE XXX.—*Estimated Acreage of Citrus Fruits by Counties, 1926.*

	Grapefruit		Lemons		Oranges	
	Bearing	*Non-bearing	Bearing	*Non-bearing	Bearing	*Non-bearing
The State	5,682	3,386	44,798	2,165	183,859	11,143
Northern California.						
Butte	10	1	7	8	1,534	128
Colusa	25	--------	729	--------	24	10
Glenn	20	--------	93	--------	778	29
Placer	--------	--------	--------	--------	235	--------
Sacramento	40	--------	23	15	1,410	--------
Solano	--------	--------	--------	--------	14	--------
Tehama	--------	--------	--------	--------	20	6
Yolo	--------	--------	--------	--------	17	--------
Yuba	--------	--------	--------	--------	19	8
Central California.						
Fresno	10	--------	260	60	4,459	154
Kern	24	--------	12	--------	1,239	27
Merced	--------	--------	--------	--------	9	14
San Joaquin	--------	--------	--------	--------	130	1
Stanislaus	--------	--------	16	2	116	2
Tulare	1,175	6	2,682	6	36,239	69
Southern California.						
Imperial	1,038	2,981	--------	--------	--------	--------
Los Angeles	484	88	12,204	711	40,770	4,186
Orange	112	25	6,815	242	34,846	2,817
Riverside	474	126	5,069	36	17,184	373
San Bernardino	2,210	119	5,523	143	39,968	711
San Diego	42	37	4,054	338	1,411	567
Santa Barbara	8	--------	1,565	75	145	45
Ventura	10	3	5,746	529	3,292	1,996

*1925 plantings not included.

Estimated acreage planted in state, 1925: Grapefruit, 115; lemons, 242; oranges, 2,505.

Data on the acreage of citrus fruits by counties have been arranged according to the districts recognized by the Citrus Exchange, growers, and the trade in general. Many of the other counties have a few orange and lemon trees growing in yards and family orchards but which cannot be considered of commercial importance.

TABLE XXXI.—*Estimated Acreage of Oranges by Varieties, 1926.*

	Navels		Valencias		Miscellaneous	
	Bearing	*Non-bearing	Bearing	*Non-bearing	Bearing	*Non-bearing
Los Angeles	17,268	831	22,792	3,355	710	--------
Orange	1,296	--------	33,285	2,817	265	--------
Riverside	14,143	244	2,635	129	406	--------
San Bernardino	29,857	463	9,176	248	935	--------
Tulare	26,226	39	9,547	26	466	4

*1925 plantings not included.

TABLE XXXII.—*Estimated Acreage of Almonds, Walnuts and Total Trees by Counties, 1926.*

	Almonds		Walnuts		Total acreage all fruit and nut trees	
	Bearing	*Non-bearing	Bearing	*Non-bearing	Bearing	*Non-bearing
The State	75,311	25,844	72,593	35,166	966,620	257,262
District No. 1.						
Del Norte	----------	----------	----------	----------	4	----------
Humboldt	----------	----------	75	----------	1,495	156
Mendocino	11	----------	50	105	4,022	3,122
District No. 2						
Shasta	40	----------	20	15	2,390	1,345
Siskiyou	6	----------	15	5	1,097	254
Trinity	----------	----------	----------	----------	79	----------
District No. 3.						
Lassen	----------	----------	----------	----------	160	----------
Modoc	----------	----------	----------	----------	413	15
Plumas	----------	----------	----------	----------	34	----------
District No. 4.						
Alameda	200	20	100	50	9,677	2,749
Contra Costa	2,700	231	2,650	1,659	12,054	5,921
Lake	421	266	706	1,079	6,572	6,335
Marin	10	7	4	10	413	197
Monterey	4,003	100	3	155	10,141	2,625
Napa	25	18	150	250	10,641	6,507
San Benito	135	21	157	90	10,224	2,358
San Luis Obispo	15,668	18,278	382	112	23,256	21,149
San Mateo	10	19	100	39	1,296	760
Santa Clara	300	150	2,060	900	92,290	10,619
Santa Cruz	----------	----------	----------	----------	19,863	1,465
Sonoma	30	10	680	575	29,100	15,923
District No. 5.						
Butte	7,837	153	252	384	25,774	4,436
Colusa	5,326	670	66	37	9,316	4,283
Glenn	2,904	256	155	184	9,269	4,559
Sacramento	2,100	200	200	75	22,944	8,671
Solano	1,500	168	150	52	25,842	2,396
Sutter	2,147	98	412	160	21,088	8,454
Tehama	915	141	217	70	7,468	2,040
Yolo	9,730	2,278	150	34	19,314	6,321
Yuba	90	40	30	212	4,531	3,900
District No. 5a.						
Fresno	150	25	300	25	47,995	8,430
Kern	65	3	61	----------	6,705	2,959
Kings	20	----------	25	50	9,093	2,710
Madera	161	152	----------	----------	5,981	4,270
Merced	3,920	1,172	205	609	25,304	15,294
San Joaquin	5,875	140	3,961	922	26,727	8,650
Stanislaus	4,067	846	338	411	22,346	6,280
Tulare	878	132	993	803	88,441	19,114
District No. 6.						
Alpine	----------	----------	----------	----------	1	----------
Amador	21	----------	----------	----------	734	22
Calaveras	30	----------	35	10	591	61
El Dorado	----------	----------	40	4	3,924	1,318
Inyo	----------	----------	----------	1	1,228	606
Mariposa	----------	----------	----------	----------	269	11
Mono	----------	----------	----------	----------	72	----------
Nevada	----------	----------	112	----------	2,302	3
Placer	409	6	----------	----------	21,840	3,736
Sierra	----------	----------	----------	----------	19	----------
Tuolumne	1	----------	60	30	1,610	658
District No. 8.						
Imperial	----------	----------	----------	----------	1,248	2,991
Los Angeles	1,069	73	21,616	11,237	95,718	20,335
Orange	----------	----------	14,199	528	56,563	3,976
Riverside	1,362	----------	1,412	2,016	43,202	6,045
San Bernardino	15	----------	2,945	2,467	72,174	4,828
San Diego	390	108	512	493	12,097	2,777
Santa Barbara	3	----------	5,200	260	8,127	770
Ventura	767	63	11,795	9,048	31,542	14,858

*1925 plantings not included.

Estimated acreage planted in state, 1925: Almonds, 1,182; walnuts, 7,913; all fruit and nut trees, 41,618.

TABLE XXXIII.—*Estimated Acreage of Grapes by Classes and by Counties, 1926.*

	Bearing			Non-bearing			Total
	Wine	Table	Raisin	Wine	Table	Raisin	Bearing and non-bearing
The State	156,945	144,200	352,091	17,429	7,393	2,737	680,795
District No. 1.							
Humboldt	70	--------	--------	--------	--------	--------	70
Mendocino	8,000	--------	--------	1,050	--------	--------	9,050
District No. 2.							
Shasta	125	60	50	55	25	35	350
Siskiyou	15	21	--------	--------	--------	--------	36
Trinity	5	--------	--------	--------	--------	--------	5
District No. 3.							
Lassen	10	--------	--------	--------	--------	--------	10
District No. 4.							
Alameda	3,525	--------	--------	510	--------	--------	4,035
Contra Costa	3,399	550	4	556	--------	--------	4,509
Lake	363	--------	--------	41	--------	--------	404
Marin	225	--------	--------	60	--------	--------	285
Monterey	230	80	--------	--------	--------	--------	310
Napa	10,850	--------	--------	500	--------	--------	11,350
San Benito	1,215	--------	--------	6	--------	--------	1,221
San Luis Obispo	670	--------	--------	168	--------	--------	838
San Mateo	135	--------	--------	35	--------	--------	170
Santa Clara	9,646	--------	--------	616	--------	--------	10,262
Santa Cruz	1,500	170	--------	--------	--------	--------	1,670
Sonoma	18,550	--------	--------	1,650	--------	--------	20,200
District No. 5.							
Butte	530	125	--------	261	110	--------	1,026
Colusa	170	190	1,180	45	--------	--------	1,585
Glenn	19	284	369	139	110	157	1,078
Sacramento	4,470	12,000	9	470	150	--------	17,099
Solano	1,555	239	--------	192	--------	--------	1,986
Sutter	548	86	8,531	455	--------	40	9,660
Tehama	296	66	228	195	30	--------	815
Yolo	1,350	1,050	1,650	392	157	130	4,729
Yuba	306	225	2,954	--------	--------	50	3,535
District No. 5a.							
Fresno	13,800	33,500	181,815	1,920	750	500	232,285
Kern	1,525	7,449	11,887	278	1,093	36	22,268
Kings	256	467	18,762	100	160	140	19,885
Madera	4,425	4,683	21,325	120	15	89	30,657
Merced	2,304	8,169	11,368	821	252	189	23,103
San Joaquin	23,868	32,807	800	1,294	1,133	--------	59,902
Stanislaus	6,128	7,137	12,363	1,895	302	396	28,221
Tulare	1,598	18,675	63,242	398	1,341	582	85,836
District No. 6.							
Amador	20	--------	--------	--------	--------	--------	20
Calaveras	324	102	19	--------	--------	--------	445
Eldorado	200	54	--------	134	--------	--------	388
Inyo	130	80	--------	--------	25	--------	235
Mariposa	35	--------	--------	--------	--------	--------	35
Nevada	130	42	--------	20	--------	--------	192
Placer	3,648	1,566	--------	109	118	--------	5,441
Tuolumne	400	225	5	35	25	1	691
District No. 8.							
Imperial	--------	5,201	1,614	--------	87	40	6,942
Los Angeles	6,055	294	--------	422	58	--------	6,829
Orange	40	20	--------	22	--------	--------	82
Riverside	939	3,279	913	691	506	--------	6,328
San Bernardino	20,925	2,667	9,356	1,612	371	322	35,253
San Diego	2,288	2,060	3,647	133	180	30	8,338
Santa Barbara	130	105	--------	29	29	--------	293
Ventura	--------	472	--------	--------	366	--------	838

TABLE XXXIV.—*Estimated Acreage Planted to Grapes in 1924 and 1925.*

	Planted—1924			Planted—1925		
	Wine	Table	Raisin	Wine	Table	Raisin
The State	9,062	5,366	2,009	8,367	2,027	728
District No. 1.						
Mendocino	650	----------	----------	400	----------	----------
District No. 2						
Shasta	20	10	35	35	15	----------
District No. 4.						
Alameda	210	----------	----------	300	----------	----------
Contra Costa	371	----------	----------	185	----------	----------
Lake	29	----------	----------	12	----------	----------
Marin	50	----------	----------	10	----------	----------
Napa	200	----------	----------	300		
San Benito	6	----------	----------	----------	----------	----------
San Luis Obispo	147	----------	----------	21	----------	----------
San Mateo	22	----------	----------	13	----------	----------
Santa Clara	200	----------	----------	416	----------	----------
Sonoma	800	----------	----------	850	----------	----------
District No. 5.						
Butte	12	48	----------	249	62	----------
Colusa	45	----------	----------	----------	----------	----------
Glenn	123	110	157	16	----------	----------
Sacramento	400	100	----------	70	50	----------
Solano	100	----------	----------	92	----------	----------
Sutter	82	----------	39	373	----------	1
Tehama	170	23	----------	25	7	----------
Yolo	223	117	35	169	40	95
Yuba	----------	----------	40	----------	----------	10
District No. 5a.						
Fresno	1,000	750	500	920	----------	----------
Kern	278	1,093	36	----------	----------	----------
Kings	80	150	110	20	10	30
Madera	20	15	89	100	----------	----------
Merced	212	216	126	609	36	63
San Joaquin	674	1,133	----------	620	----------	----------
Stanislaus	551	89	133	1,344	213	263
Tulare	195	683	424	203	658	158
District No. 6.						
El Dorado	112	----------	----------	22	----------	----------
Inyo	----------	15	----------	----------	10	----------
Nevada	15	----------	----------	5	----------	----------
Placer	109	84	----------	----------	34	----------
Tuolumne	20	15	1	15	10	----------
District No. 8.						
Imperial	----------	87	40	----------	----------	----------
Los Angeles	249	34	----------	173	24	----------
Orange	12	----------	----------	10	----------	----------
Riverside	537	353	----------	154	153	----------
San Bernardino	1,010	184	214	602	187	108
San Diego	108	20	30	25	160	----------
Santa Barbara	20	20	----------	9	9	----------
Ventura	----------	17	----------	----------	349	----------

TABLE XXXV.—*Estimated Acreage of Peaches (Clingstone and Freestone) by Counties, 1926.*

	Clingstone			Freestone		
	Bearing	Non-bearing	1925 Plantings	Bearing	Non-bearing	1925 Plantings
The State	66,715	26,339	5,534	64,772	11,889	2,533
District No. 1.						
Humboldt	45	5	----------	45	4	----------
Mendocino	76	31	----------	75	31	----------
District No. 2.						
Shasta	100	----------	10	400	30	25
Siskiyou	3	1	----------	27	8	----------
District No. 3.						
Lassen	15	----------	----------	14	----------	----------
Modoc	6	----------	----------	5	----------	----------
District No. 4.						
Alameda	75	100	5	75	100	5
Contra Costa	280	153	15	596	460	45
Lake	25	27	10	25	28	11
Marin	4	8	4	34	2	1
Monterey	10	----------	----------	195	----------	----------
Napa	10	4	15	90	1	5
San Benito	377	117	----------	147	12	----------
San Luis Obispo	45	8	5	855	142	95
San Mateo	45	36	22	45	35	22
Santa Clara	762	378	326	1,710	190	109
Santa Cruz	12	10	----------	113	90	----------
Sonoma	195	161	55	130	69	30
District No. 5.						
Butte	1,258	1,178	400	1,436	32	12
Colusa	41	720	----------	10	18	----------
Glenn	31	386	45	377	665	336
Sacramento	2,151	869	258	624	96	51
Solano	----------	----------	----------	2,954	271	309
Sutter	10,695	6,030	1,558	406	13	8
Tehama	----------	----------	----------	1,639	487	215
Yolo	361	284	20	1,903	31	66
Yuba	1,230	1,922	310	200	----------	----------
District No. 5a.						
Fresno	5,360	254	261	11,712	174	85
Kern	48	121	----------	253	478	----------
Kings	1,292	213	2	2,908	1,037	90
Madera	1,300	243	12	1,592	483	8
Merced	6,724	3,799	111	5,050	1,862	100
San Joaquin	3,710	1,423	85	2,362	152	10
Stanislaus	7,353	2,256	997	2,783	252	152
Tulare	5,873	3,781	496	6,686	3,549	282
District No. 6.						
Amador	42	1	----------	141	----------	----------
Calaveras	22	----------	----------	52	----------	----------
El Dorado	250	13	14	250	12	14
Inyo	37	5	----------	38	5	----------
Mariposa	12	----------	----------	12	----------	----------
Mono	1	----------	----------	1	----------	----------
Nevada	105	----------	----------	70	----------	----------
Placer	2,289	639	193	6,111	256	76
Tuolumne	74	5	2	50	5	3
District No. 8.						
Imperial	----------	----------	----------	----------	----------	----------
Los Angeles	3,380	403	186	3,882	199	50
Orange	10	5	----------	10	5	----------
Riverside	4,719	320	15	1,444	58	----------
San Bernardino	6,159	393	92	3,576	176	103
San Diego	61	10	6	1,367	310	194
Santa Barbara	----------	----------	----------	250	33	17
Ventura	42	27	4	42	28	4

TABLE XXXVI.—*Estimated Acreage of Peaches by Age and Variety for California, 1926.*

Varieties	Total acreage by varieties	Number of acres of peach trees of each age					
		One year old	2 and 3 years old	4 and 5 years old	6 and 7 years old	8 and 9 years old	10 years old and over
Clingstones.							
Phillips	36,909	1,954	10,887	9,238	3,873	1,936	9,021
Tuscan	29,650	604	4,607	5,245	4,138	2,596	12,460
Palora	8,990	1,403	5,222	2,247	107	11	--------
Peak	4,902	439	1,797	1,952	338	345	31
Orange	3,377	35	351	436	287	168	2,100
Hauss	2,977	123	563	504	679	307	801
Levy	1,598	17	65	85	105	21	1,305
All other yellow clings	9,877	927	2,763	3,356	902	434	1,495
All other white clings	308	32	84	15	5	1	171
Total clingstones	98,588	5,534	26,339	23,078	10,434	5,819	27,384
Freestones.							
Muir	23,094	331	3,037	1,817	1,023	818	16,068
Elberta	23,028	1,160	3,996	3,227	832	1,103	12,710
Lovell	19,663	544	2,928	2,401	1,222	895	11,673
(Early and late) Crawfords	2,647	43	102	166	54	45	2,237
J. H. Hale	2,022	159	1,142	322	127	117	155
Salway	1,890	87	81	61	133	61	1,467
Alexander	804	24	49	50	39	22	620
Hale's early	640	21	31	38	13	20	517
All other yellow frees	5,089	163	494	236	254	234	3,708
All other white frees	317	1	29	9	30	10	238
Total freestones	79,194	2,533	11,889	8,327	3,727	3,325	49,393
Total state	177,782	8,067	38,228	31,405	14,161	9,144	76,777

TABLE XXXVII.—*Estimated Acreage of Peaches by Age and Variety—Northern California, 1926.*

Varieties	Total acreage by varieties	Number of acres of peach trees of each age					
		One year old	2 and 3 years old	4 and 5 years old	6 and 7 years old	8 and 9 years old	10 years old and over
Clingstones.							
Phillips	13,074	970	4,954	3,669	1,011	503	1,967
Tuscan	7,319	100	1,638	1,399	640	354	3,088
Palora	3,253	671	2,028	554	--------	--------	--------
Peak	1,516	250	861	386	7	1	11
Orange	422	8	3	60	24	14	313
Hauss	2,330	109	478	347	484	172	740
Levy	1,297	15	60	51	88	141	1,069
All other yellow clings	4,877	669	2,257	900	245	248	558
All other white clings	15	--------	--------	--------	2	--------	13
Total clingstones	34,103	2,892	12,279	7,366	2,501	1,306	7,759
Freestones.							
Muir	4,021	190	313	497	196	217	2,608
Elberta	7,963	646	1,152	732	350	329	4,754
Lovell	2,135	97	138	112	71	87	1,630
(Early and late) Crawfords	1,611	39	94	58	37	23	1,360
J. H. Hale	149	41	24	37	1	1	45
Salway	376	13	23	14	6	3	317
Alexander	270	14	49	26	19	22	140
Hale's early	520	9	31	16	7	9	448
All other yellow frees	2,957	110	222	122	111	106	2,286
All other white frees	177	--------	8	3	--------	10	156
Total freestones	20,179	1,159	2,054	1,617	798	807	13,744
Total all peaches	54,282	4,051	14,333	8,983	3,299	2,113	21,503

Note.—Northern California includes the counties of Amador, Butte, Colusa, Del Norte, El Dorado, Glenn, Humboldt, Lake, Lassen, Marin, Mendocino, Modoc, Napa, Nevada, Placer, Plumas, Sacramento, Shasta, Sierra, Siskiyou, Solano, Sonoma, Sutter, Tehama, Trinity, Yolo and Yuba.

TABLE XXXVIII.—*Estimated Acreage of Peaches by Age and Variety—Central California, 1926.*

Varieties	Total acreage by varieties	Number of acres of peach trees of each age					
		One year old	2 and 3 years old	4 and 5 years old	6 and 7 years old	8 and 9 years old	10 years old and over
Clingstones.							
Phillips	18,045	895	5,658	4,902	2,007	703	3,880
Tuscan	15,293	253	2,582	2,791	2,327	909	6,431
Palora	5,581	708	3,084	1,673	105	11	--------
Peak	3,118	179	853	1,517	205	344	20
Orange	2,731	27	344	376	261	122	1,601
Hauss	642	13	81	157	195	135	61
Levy	243	2	4	34	17	7	179
All other yellow clings	2,747	230	212	1,415	270	102	518
All other white clings	253	32	84	15	2	--------	120
Total clingstones	48,653	2,339	12,902	12,880	5,389	2,333	12,810
Freestones.							
Muir	17,776	138	2,724	1,309	817	508	12,280
Elberta	13,207	509	2,821	2,352	394	533	6,598
Lovell	11,837	232	2,370	1,599	525	271	6,840
(Early and late) Crawfords	856	1	8	108	16	21	702
J. H. Hale	1,154	34	847	87	61	93	32
Salway	674	57	24	15	11	26	541
Alexander	506	5	--------	21	--------	--------	480
Hale's early	105	--------	--------	22	6	11	66
All other yellow frees	1,069	29	211	88	24	30	687
All other white frees	83	1	21	6	--------	--------	55
Total freestones	47,267	1,006	9,026	5,607	1,854	1,493	28,281
Total all peaches	95,920	3,345	21,928	18,487	7,243	3,826	41,091

Note.—Central California includes the counties of Alameda, Alpine, Calaveras, Contra Costa, Fresno Inyo, Kern, Kings, Madera, Mariposa, Merced, Mono, Monterey, San Benito, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Santa Cruz, Stanislaus and Tuolumne.

TABLE XXXIX.—*Estimated Acreage of Peaches by Age and Variety—Southern California, 1926.*

Varieties	Total acreage by varieties	Number of acres of peach trees of each age					
		One year old	2 and 3 years old	4 and 5 years old	6 and 7 years old	8 and 9 years old	10 years old and over
Clingstones.							
Phillips	5,790	89	275	667	855	730	3,174
Tuscan	7,038	151	387	1,055	1,171	1,333	2,941
Palora	156	24	110	20	2	--------	--------
Peak	268	10	83	49	126	--------	--------
Orange	224	--------	4	--------	2	32	186
Hauss	5	1	4	--------	--------	--------	--------
Levy	58	--------	1	--------	--------	--------	57
All other yellow clings	2,253	28	294	1,041	387	84	419
All other white clings	40	--------	--------	--------	1	1	38
Total clingstones	15,832	303	1,158	2,832	2,544	2,180	6,815
Freestones							
Muir	1,297	3	--------	11	10	93	1,180
Elberta	1,858	5	23	143	88	241	1,358
Lovell	5,691	215	420	690	626	537	3,203
(Early and late) Crawfords	180	3	--------	--------	1	1	175
J. H. Hale	719	84	271	198	65	23	78
Salway	840	17	34	32	116	32	609
Alexander	28	5	--------	3	20	--------	--------
Hale's early	15	12	--------	--------	--------	--------	3
All other yellow frees	1,063	24	61	26	119	98	735
All other white frees	57	--------	--------	--------	30	--------	27
Total freestones	11,748	368	809	1,103	1,075	1,025	7,368
Total all peaches	27,580	671	1,967	3,935	3,619	3,205	14,183

Note.—Southern California includes the counties of Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara and Ventura.

LIVE STOCK ESTIMATES.

HORSES, MULES AND SHEEP.

The number of horses in California on January 1, 1926, shows a decrease of about 5 per cent when compared with the previous year while the number of mules decreased about 2 per cent. Sheep increased in number during the year and on January 1, 1926, was about six per cent greater than on the same date in 1925.

In Table XLI is shown the number of horses and mules on farms enumerated by the quinquennial Census of Agriculture as of January 1, 1925. and the estimated number on January 1, 1926. The Census data on sheep were so delayed in publication that the number of sheep on January 1, 1925, is part estimate and part enumeration.

The total number of horses, mules and sheep in the state; the values per head of different ages; and the total value as of January 1, compared with the previous year are given in Table XL.

TABLE XL.—*Numbers and Values of Horses, Mules and Sheep as of January 1, 1925-1926.*

	1925	1926
Horses (value per head).		
Under 1 year	$28 00	$27 00
1 to 2 years	46 00	43 00
2 years and over	80 00	78 00
All ages	78 00	76 00
Total number	317,000	302,000
Total value	$24,760,000	$22,952,000
Mules (value per head).		
Under 1 year	$35 00	$32 00
1 to 2 years	55 00	49 00
2 years and over	100 00	97 00
All ages	93 00	87 00
Total number	56,000	55,000
Total value	$5,230,000	$4,770,000
Sheep (value per head).		
Lambs	$7 60	$8 50
Ewes	9 40	11 00
Wethers	7 40	9 20
Rams	20 00	23 00
All sheep	9 20	10 60
Total number	2,824,000	2,983,000
Total value	$25,981,000	$31,620,000

TABLE XLI.—*Estimated Number of Horses, Mules, and Sheep, January 1, 1925-1926.*

Counties	Horses		Mules		Sheep	
	1925	1926	1925	1926	1925	1926
District No. 1.						
Del Norte	494	500	15	15	994	1,000
Humboldt	5,746	5,600	282	280	70,562	73,000
Mendocino	4,135	4,000	411	410	128,155	132,000
District No. 2.						
Shasta	3,934	3,900	332	330	34,455	36,000
Siskiyou	5,945	5,900	441	440	10,331	12,000
Trinity	883	900	139	140	4,307	4,400
District No. 3.						
Lassen	6,284	6,000	989	980	75,528	78,000
Modoc	8,731	8,000	921	900	80,565	83,000
Plumas	1,309	1,300	63	60	1,306	1,300
District No. 4.						
Alameda	5,767	5,500	99	100	15,963	17,000
Contra Costa	5,534	5,500	420	400	32,903	34,000
Lake	1,656	1,600	243	240	17,929	19,000
Marin	2,328	2,200	124	120	5,477	5,500
Monterey	10,477	10,200	890	860	12,733	14,000
Napa	2,962	2,900	261	260	25,172	27,000
San Benito	3,645	3,600	36	35	27,029	28,000
San Luis Obispo	9,648	9,400	602	580	2,961	3,000
San Mateo	2,575	2,500	63	60	70,271	60,000
Santa Clara	8,455	8,000	388	380	863	900
Santa Cruz	2,865	2,800	85	80	2,045	2,100
Sonoma	11,894	11,000	428	410	73,093	78,000
District No. 5.						
Butte	4,514	4,200	643	600	80,469	82,000
Colusa	2,592	2,500	2,066	2,000	162,202	171,000
Glenn	3,493	3,400	1,643	1,600	222,428	232,000
Sacramento	8,345	8,000	540	520	35,153	40,000
Solano	4,646	4,300	998	960	162,027	166,000
Sutter	3,142	3,100	848	830	51,972	53,000
Tehama	5,062	4,800	1,535	1,500	231,101	240,000
Yolo	5,713	5,400	1,498	1,450	125,459	140,000
Yuba	2,526	2,400	343	330	57,353	58,000
District No. 5a.						
Fresno	18,865	17,800	4,989	4,900	163,793	180,000
Kern	9,914	9,200	2,580	2,550	159,806	193,000
Kings	7,124	6,500	1,465	1,450	98,334	110,000
Madera	4,230	4,000	2,163	2,140	30,367	32,000
Merced	8,651	8,200	1,978	1,940	86,178	95,000
San Joaquin	14,844	14,000	1,450	1,400	68,349	70,000
Stanislaus	10,632	10,000	1,656	1,600	32,996	35,000
Tulare	16,012	15,000	4,266	4,200	95,625	106,000
District No. 6.						
Alpine	154	150	4	5	11,744	10,000
Amador	1,318	1,200	55	55	15,317	16,000
Calaveras	1,801	1,700	63	60	31,903	33,000
Eldorado	1,850	1,800	107	100	16,059	16,000
Inyo	3,386	3,200	695	680	29,069	28,000
Mariposa	1,268	1,200	289	280	9,271	9,300
Mono	920	900	74	70	24,736	25,000
Nevada	948	900	40	40	7,846	8,000
Placer	3,100	3,000	397	380	34,861	34,000
Sierra	569	550	19	20	501	500
Tuolumne	1,794	1,700	89	90	4,573	4,600
District No. 8.						
Imperial	10,270	10,000	3,823	3,800	41,528	45,000
Los Angeles	11,296	10,000	1,890	1,880	7,697	8,000
Orange	4,632	4,500	2,666	2,640	1,330	1,300
Riverside	8,698	8,500	2,395	2,350	13,701	14,000
San Bernardino	5,945	5,800	1,159	1,120	1,880	1,900
San Diego	7,988	7,800	1,312	1,280	2,580	2,600
Santa Barbara	7,979	7,800	356	350	6,198	6,400
Ventura	7,323	7,200	2,991	2,950	6,828	7,200
State	316,811	302,000	56,317	55,200	2,823,876	2,983,000

MILK COWS, ALL OTHER CATTLE AND SWINE.

The quinquennial Census of Agriculture changed the classification of cattle somewhat when compared with the previous census and such classification has been adopted by the Division of Crop and Livestock Estimates. In Tables XLIII and XLIV are shown by counties the number of the different classes of cattle by sex and age as enumerated by the Census of Agriculture as of January 1, 1925, and the estimated number as of January 1, 1926. The number of all cattle decreased about 5 per cent or 100,000 head from January 1, 1920, to January 1, 1925. The number of milk cows, 2 years old and over, increased about 13.6 per cent or 70,000 head during the 5-year period.

In Table XLIII is shown the estimated number of swine on farms by counties on January 1, 1925 and 1926.

The total number of milk cows, 2 years old and over, and all other cattle; the values per head for different ages; the number of swine and value per head and the total value of milk cows, all other cattle and swine as of January 1, compared with the previous year are given in Table XLII.

TABLE XLII.—*Numbers and Values of Milk Cows, All Other Cattle and Swine as of January 1, 1925-1926.*

	1925	1926
Milk Cows (value per head)	$73 00	$77 00
Total number	585,000	603,000
Total value	$42,705,000	$46,431,000
All other cattle (value per head).		
Under 1 year	$16 00	$18 00
1 to 2 years	26 00	30 00
2 years and over	40 00	46 00
All ages	30 30	34 15
Total number	1,323,000	1,362,000
Total value	$40,102,000	$46,508,000
Swine (value per head).		
All ages	$10 20	$15 20
Total number	532,000	468,000
Total value	$5,426,000	$7,114,000

TABLE XLIII.—*Estimated Number of Milk Cows, Heifers for Milk, and Swine, January 1, 1925-1926.*

Counties	Milk Cows 2 years old and over		Heifers 1 to 2 years for milk		Swine Including Pigs	
	1925	1926	1925	1926	1925	1926
District No. 1.						
Del Norte	4,641	4,700	927	930	550	550
Humboldt	26,214	26,500	10,364	10,500	6,800	6,000
Mendocino	8,183	8,300	1,411	1,400	16,500	13,000
District No. 2.						
Shasta	3,292	3,500	786	800	18,000	16,000
Siskiyou	8,140	8,400	1,367	1,400	11,400	11,000
Trinity	478	500	109	110	5,000	5,000
District No. 3.						
Lassen	3,086	3,300	518	530	3,500	3,500
Modoc	3,845	3,900	701	700	5,500	5,000
Plumas	2,373	2,400	725	730	1,000	1,000
District No. 4.						
Alameda	11,636	12,000	2,222	2,300	10,500	9,000
Contra Costa	8,907	9,300	971	1,000	6,000	5,500
Lake	1,922	2,000	327	350	5,500	5,000
Marin	25,299	26,000	5,289	5,400	11,000	10,000
Monterey	21,622	23,000	3,330	3,500	13,000	11,000
Napa	4,676	4,800	701	700	13,000	12,000
San Benito	2,994	3,100	719	750	4,000	4,000
San Luis Obispo	21,003	21,000	4,115	4,200	13,000	12,000
San Mateo	10,095	10,400	2,811	2,900	3,000	3,000
Santa Clara	12,064	12,400	2,468	2,500	4,500	4,200
Santa Cruz	3,495	3,500	611	600	2,400	2,200
Sonoma	26,309	27,000	5,565	5,700	13,000	12,000
District No. 5.						
Butte	5,832	6,000	1,133	1,200	17,500	16,000
Colusa	3,594	3,800	1,075	1,100	21,000	19,000
Glenn	8,004	8,400	2,232	2,300	13,500	13,000
Sacramento	10,451	11,000	1,957	2,000	6,000	5,500
Solano	7,196	7,500	1,498	1,600	6,000	5,500
Sutter	4,238	4,600	979	1,000	9,000	9,000
Tehama	3,904	4,200	944	1,000	13,000	11,000
Yolo	9,041	9,400	2,306	2,400	29,500	26,000
Yuba	2,930	3,100	838	900	4,000	3,500
District No. 5a.						
Fresno	23,278	25,000	5,390	5,500	15,500	13,000
Kern	10,207	10,800	2,530	2,600	12,500	11,000
Kings	20,387	21,000	6,658	6,700	14,500	12,000
Madera	6,595	6,700	1,549	1,600	8,000	7,000
Merced	35,154	36,500	6,732	6,800	13,000	10,000
San Joaquin	25,928	26,500	14,980	15,000	15,500	13,000
Stanislaus	37,577	38,500	8,831	9,000	9,500	9,000
Tulare	30,871	31,500	8,021	8,300	28,000	22,000
District No. 6.						
Alpine	288	300	150	150	250	250
Amador	1,246	1,300	171	180	4,100	3,800
Calaveras	1,302	1,300	213	220	3,300	3,000
Eldorado	2,520	2,500	496	510	2,000	1,800
Inyo	1,916	1,900	578	600	1,200	1,000
Mariposa	324	300	35	40	5,500	5,000
Mono	294	300	57	60	300	300
Nevada	1,729	1,800	341	350	1,600	1,300
Placer	2,453	2,500	405	420	2,400	2,000
Sierra	1,397	1,400	566	570	400	400
Tuolumne	1,043	1,100	198	200	2,800	2,500
District No. 8.						
Imperial	28,484	29,000	10,364	10,500	26,000	22,000
Los Angeles	37,868	38,500	4,054	4,100	22,000	19,500
Orange	6,848	7,200	1,147	1,200	1,500	1,500
Riverside	9,133	9,500	2,250	2,300	6,000	5,600
San Bernardino	10,417	11,000	1,860	1,900	26,000	20,000
San Diego	10,533	11,000	3,115	3,200	12,500	11,000
Santa Barbara	8,008	8,400	1,817	1,900	7,000	7,000
Ventura	3,096	3,200	557	600	4,000	3,600
State	584,360	603,000	142,064	145,000	532,000	468,000

TABLE XLIV.—*Estimated Number of Beef Cows, Heifers not for milk, and Steers, Calves and Bulls, January 1, 1925-1926.*

	Beef cows 2 years old and over		Heifers 1 to 2 years not for milk		Steers, Calves and Bulls	
	1925	1926	1925	1926	1925	1926
District No. 1.						
Del Norte	406	400	143	140	1,923	1,930
Humboldt	13,673	13,800	7,506	7,600	24,624	24,800
Mendocino	7,884	7,900	2,067	2,100	10,337	10,400
District No. 2.						
Shasta	13,545	13,500	4,475	4,500	15,169	15,300
Siskiyou	14,206	14,200	5,873	5,900	22,468	22,610
Trinity	6,174	6,100	1,455	1,500	3,564	3,590
District No. 3.						
Lassen	12,302	12,300	3,975	4,100	12,832	13,020
Modoc	25,113	25,200	7,287	7,400	26,622	27,000
Plumas	825	800	402	400	3,880	3,900
District No. 4.						
Alameda	4,130	4,800	1,340	1,500	11,811	11,980
Contra Costa	5,742	6,000	1,311	1,400	6,993	7,120
Lake	1,347	1,400	654	700	2,591	2,670
Marin	276	300	184	200	5,316	5,350
Monterey	10,611	11,200	5,042	5,200	17,878	18,250
Napa	3,741	3,900	698	700	3,932	4,050
San Benito	9,417	10,200	2,523	2,700	9,862	10,190
San Luis Obispo	15,547	16,200	3,857	4,000	32,811	33,170
San Mateo	211	300	266	260	2,826	2,940
Santa Clara	6,691	7,000	2,920	3,000	15,591	16,120
Santa Cruz	668	700	286	300	2,533	2,500
Sonoma	2,633	2,800	741	800	7,882	8,280
District No. 5.						
Butte	8,588	9,000	1,651	1,700	7,287	7,610
Colusa	6,127	6,300	1,090	1,200	5,236	5,450
Glenn	3,807	4,000	913	1,000	8,258	8,550
Sacramento	4,162	4,500	2,786	2,900	8,060	8,380
Solano	3,390	3,600	513	550	4,244	4,490
Sutter	1,553	1,700	534	550	2,677	2,850
Tehama	15,546	16,500	4,603	4,700	19,372	19,980
Yolo	3,092	3,300	1,157	1,200	6,329	6,460
Yuba	5,373	5,500	1,499	1,500	5,652	5,760
District No. 5a.						
Fresno	17,594	19,000	7,672	8,000	40,986	41,930
Kern	40,486	41,000	5,698	5,800	38,497	39,160
Kings	3,321	3,600	966	1,000	9,629	9,870
Madera	8,707	9,200	977	1,000	10,212	10,410
Merced	10,317	11,300	1,104	1,200	16,881	17,540
San Joaquin	5,585	6,200	640	700	11,844	12,740
Stanislaus	5,043	5,400	1,426	1,500	16,340	16,900
Tulare	16,170	17,200	5,451	5,500	40,357	41,000
District No. 6.						
Alpine	556	600	191	200	1,095	1,140
Amador	6,597	6,800	972	1,000	5,119	5,130
Calaveras	8,230	8,500	2,100	2,200	9,842	9,960
Eldorado	4,209	4,500	1,149	1,200	4,685	4,800
Inyo	6,319	6,500	2,931	3,000	8,907	8,920
Mariposa	5,499	5,800	1,695	1,800	5,374	5,490
Mono	3,017	3,200	917	1,000	5,604	5,650
Nevada	2,298	2,500	588	600	2,331	2,410
Placer	1,681	1,800	343	400	1,968	2,040
Sierra	937	1,000	210	200	2,647	2,680
Tuolumne	6,123	6,500	1,510	1,600	4,623	4,790
District No. 8.						
Imperial	2,924	3,200	505	600	32,329	32,730
Los Angeles	2,335	2,700	914	1,000	9,613	10,020
Orange	758	1,000	568	600	8,464	8,610
Riverside	3,337	3,600	1,107	1,200	6,651	6,950
San Bernardino	8,896	10,000	3,760	3,800	17,234	17,690
San Diego	11,590	12,000	4,223	4,400	20,449	20,860
Santa Barbara	10,744	11,500	3,863	4,000	11,429	11,840
Ventura	2,770	3,000	689	800	6,996	7,100
State	402,823	421,000	119,920	124,000	658,636	672,460

Table XLV.—*Estimated Number, Value per Head and Total Value of the Different Classes of Live Stock on Farms in California and the United States on January 1, 1920-1926*

Item and year	CALIFORNIA			UNITED STATES		
	Number (000 omitted)	Value per head	Total value (000 omitted)	Number (000 omitted)	Value per head	Total value (000 omitted)
Horses and colts--------1920	402	$98 00	$39,396	19,848	$96 52	$1,915,729
1921	375	98 00	36,750	19,134	84 57	1,618,162
1922	360	84 00	30,240	18,564	71 18	1,321,386
1923	335	83 00	27,805	17,943	70 65	1,267,673
1924	335	85 00	28,475	17,222	65 48	1,127,697
1925	317	78 00	24,760	16,554	64 18	1,062,511
1926	302	76 00	22,952	15,778	65 08	1,026,905
Mules and mule colts---1920	63	120 00	7,560	5,475	148 46	812,819
1921	60	123 00	7,380	5,586	117 52	656,467
1922	61	103 00	6,283	5,638	89 14	502,571
1923	62	105 00	6,510	5,702	87 17	497,043
1924	59	106 00	6,254	5,730	85 90	492,207
1925	56	93 00	5,230	5,758	82 51	475,068
1926	55	87 00	4,770	5,780	81 30	469,887
Milk cows—2 years old and over------------1920	515	97 00	49,955	21,427	85 56	1,833,294
1921	530	95 00	50,350	21,408	64 13	1,372,895
1922	550	76 00	41,800	21,788	50 97	1,110,534
1923	580	76 00	44,080	22,063	50 94	1,123,889
1924	595	76 00	45,220	22,255	52 30	1,163,937
1925	585	73 00	42,705	22,523	50 68	1,141,456
1926	603	77 00	46,431	22,290	57 37	1,278,877
All other cattle----------1920	1,493	51 90	77,553	47,444	42 19	2,001,443
1921	1,470	44 50	65,450	45,776	30 59	1,400,461
1922	1,498	34 30	51,384	45,476	23 15	1,052,676
1923	1,500	34 40	51,600	44,093	24 80	1,093,660
1924	1,547	33 35	51,598	42,252	24 44	1,032,526
1925	1,323	30 30	40,102	39,627	23 67	937,911
1926	1,362	34 15	46,508	37,539	27 14	1,018,633
*Sheep and lambs--------1920	2,500	11 00	27,500	39,025	10 47	408,586
1921	2,500	6 80	17,000	37,452	6 30	235,855
1922	2,310	5 30	12,243	36,327	4 80	174,545
1923	2,402	8 10	19,456	37,223	7 51	279,464
1924	2,570	9 00	23,130	38,300	7 87	301,455
1925	2,824	9 20	25,981	39,593	9 63	381,281
1926	2,983	10 60	31,620	40,953	10 50	430,007
Swine—including pigs---1920	909	18 00	16,362	59,813	19 08	1,141,232
1921	818	14 50	11,861	58,711	12 98	762,069
1922	818	11 70	9,571	59,355	10 06	597,111
1923	818	11 80	9,652	68,447	11 58	792,616
1924	624	10 50	6,552	65,937	9 72	640,908
1925	532	10 20	5,426	55,769	12 38	690,328
1926	468	15 20	7,114	51,223	15 21	779,348

*A revision of the estimated number of sheep and lambs on farms in California and the United States from 1920 to 1926 has not been completed in accordance with the quinquennial Census of Agriculture taken in January 1925. Rather than leave the sheep item blank in the above table, estimates made from year to year were inserted. A complete revision of the estimated number of sheep and lambs will be made later in the year.

SUMMARY OF UNITED STATES CROP REPORT.

The December estimates of the Crop Reporting Board of the United States Department of Agriculture of the ACREAGE, PRODUCTION, AND VALUE (based on prices paid to farmers on December 1) of the important farm crops of the United States in 1924 and 1925, based on the reports and data furnished by crop correspondents, field statisticians, and cooperating State Boards (or Departments) of Agriculture and Extension Departments, are given in Table XLVI.

TABLE XLVI.—*Summary of United States Crop Report.*

Crop and year	Acreage	Production			Farm value Dec. 1[1]	
		Unit	Per acre	Total	Per unit	Total
Corn 1925	101,631,000	Bushel	28.5	2,900,581,000	$0.674	$1,956,326,000
1924	101,076,000	Bushel	22.9	2,312,745,000	.982	2,270,564,000
Winter wheat 1925	31,269,000	Bushel	12.7	398,486,000	1.479	589,504,000
1924	35,489,000	Bushel	16.6	589,632,000	1.316	776,227,000
Spring wheat 1925	20,931,000	Bushel	12.9	270,879,000	1.323	358,489,000
1924	16,875,000	Bushel	16.2	272,995,000	1.262	344,560,000
All wheat 1925	52,200,000	Bushel	12.8	669,365,000	1.416	947,993,000
1924	52,364,000	Bushel	16.5	862,627,000	1.299	1,120,787,000
Oats 1925	45,160,000	Bushel	33.3	1,501,909,000	.381	571,768,000
1924	42,756,000	Bushel	35.6	1,522,665,000	.478	727,171,000
Barley 1925	8,243,000	Bushel	26.4	218,002,000	.586	127,653,000
1924	6,858,000	Bushel	26.0	178,322,000	.739	131,704,000
Rye 1925	4,088,000	Bushel	11.9	48,696,000	.781	38,026,000
1924	4,019,000	Bushel	15.9	64,038,000	1.066	68,260,000
Buckwheat 1925	776,000	Bushel	18.9	14,647,000	.892	13,058,000
1924	738,000	Bushel	18.0	13,277,000	1.030	13,673,000
Flaxseed 1925	3,012,000	Bushel	7.3	22,007,000	2.265	49,842,000
1924	3,469,000	Bushel	9.2	31,711,000	2.273	72,094,000
Rice 1925	904,000	Bushel	37.6	33,959,000	1.539	52;246,000
1924	849,000	Bushel	39.2	33,249,000	1.382	45,956,000
Grain sorghums[2] 1925	4,120,000	Bushel	17.2	71,050,000	.757	53,801,000
1924	3,813,000	Bushel	21.1	80,443,000	.852	68,501,000
Cotton lint 1925	45,945,000	Bale	[3] 162.3	15,603,000	[3] .182	1,419,888,000
1924	41,360,000	Bale	[3] 157.4	13,628,000	[3] .226	1,540,884,000
Cottonseed 1925	------------	Ton	--------	6,928,000	27.64	191,490,000
1924	------------	Ton	--------	6,051,000	[4]33.57	203,132,000
Hay, tame 1925	59,398,000	Ton	1.46	86,474,000	13.99	1,209,496,000
1924	61,451,000	Ton	1.60	98,086,000	13.76	1,349,528,000
Hay, wild 1925	14,746,000	Ton	.88	13,049,000	8.46	110,334,000
1924	15,080,000	Ton	.98	14,731,000	7.83	115,365,000
All hay 1925	74,144,000	Bushel	1.34	99,523,000	13.26	1,319,830,000
1924	76,531,000	Ton	1.47	112,817,000	12.98	1,464,893,000
Clover seed[2] 1925	789,000	Bushel	1.3	1,029,000	14.86	15,288,000
1924	809,000	Bushel	1.1	927,000	14.51	13,455,000
Beans, dry, edible[4] 1925	1,579,000	Bushel	12.1	19,100,000	3.27	62,388,000
1924	1,545,000	Bushel	9.6	14,856,000	3.72	55,239,000
Peanuts 1925	982,000	Pound	706.8	694,075,000	.036	25,225,000
1924	1,207,000	Pound	620.5	748,925,000	.046	34,481,000

TABLE XLVI.—*Summary of United States Crop Report*—Continued.

Crop and year	Acreage	Production			Farm value Dec. 1[1]	
		Unit	Per acre	Total	Per unit	Total
Potatoes, white 1925	3,113,000	Bushel	103.8	323,243,000	$1.872	$605,327,000
1924	3,348,000	Bushel	127.0	425,283,000	.626	266,047,000
Sweet potatoes 1925	778,000	Bushel	80.3	62,494,000	1.369	85,554,000
1924	691,000	Bushel	79.0	54,564,000	1.292	70,500,000
Tobacco 1925	1,747,000	Pound	772.6	1,349,660,000	.183	247,413,000
1924	1,706,000	Pound	728.3	1,242,456,000	.207	256,834,000
Sugar cane (La.) 1925	294,000	Ton	16.5	4,851,000	--------	------------
1924	301,000	Ton	7.6	2,288,000	--------	------------
Cane sugar (La.) 1925	221,000	Ton	.89	196,000	--------	------------
1924	163,000	Ton	.54	88,000	--------	------------
Cane sirup 1925	122,000	Gallon	158.9	19,390,000	.991	19,210,000
1924	145,000	Gallon	141.8	20,558,000	1.020	20,964,000
Sugar beets[5] 1925	667,000	Ton	10.39	6,932,000	--------	------------
1924	817,000	Ton	8.66	7,075,000	--------	------------
Beet sugar[5] 1925	667,000	Ton	1.34	895,000	--------	------------
1924	817,000	Ton	1.33	1,090,000	--------	------------
Sorghum sirup 1925	377,000	Gallon	67.6	25,492,000	.948	24,168,000
1924	385,000	Gallon	68.3	26,284,000	.944	24,821,000
Maple sugar and sirup as sugar 1925	[6]15,313,000	Pound	[6]1.82	27,946,000	--------	------------
1924	[6]15,407,000	Pound	[6]2.29	35,302,000	--------	------------
Broomcorn[2] 1925	200,000	Ton	[3]289.0	28,900	140.17	4,051,000
1924	451,000	Ton	[3]346.8	78,200	95.63	7,478,000
Hops[2] 1925	20,350	Pound	1,404	28,573,000	.218	6,232,000
1924	20,350	Pound	1,360	27,670,000	.103	2,863,000
FRUIT CROPS						
Apples, total 1925	------------	Bushel	--------	164,616,000	1.262	207,820,000
1924	------------	Bushel	--------	171,250,000	1.181	202,326,000
Apples, comm. 1925	------------	Barrel	--------	31,909,000	3.68	117,284,000
1924	------------	Barrel	--------	28,063,000	3.66	102,828,000
Peaches 1925	------------	Bushel	--------	46,565,000	1.398	65,086,000
1924	------------	Bushel	--------	54,119,000	1.269	68,679,000
Pears 1925	------------	Bushel	--------	19,820,000	1.410	27,944,000
1924	------------	Bushel	--------	18,868,000	1.415	26,693,000
Grapes 1925	------------	Ton	--------	1,967,160	34.04	66,969,000
1924	------------	Ton	--------	1,763,742	41.52	73,228,000
Oranges (2 States) 1925	------------	Box	--------	34,500,000	3.116	107,505,000
1924	------------	Box	--------	32,200,000	1.771	57,045,000
Cranberries[2] 1925	------------	Barrel	--------	530,000	9.88	5,238,000
1924	------------	Barrel	--------	562,000	9.86	5,554,000
COMMERCIAL TRUCK CROPS						
Asparagus 1925	56,380	Crate	114	6,442,000	1.74	11,222,000
1924	48,300	Crate	129	6,241,000	1.88	11,750,000
Beans, snap 1925	94,640	Ton	1.4	136,812	110.85	15,166,000
1924	85,000	Ton	1.3	113,564	120.62	13,698,000
Cabbage 1925	107,990	Ton	8.1	869,200	20.20	17,560,000
1924	108,670	Ton	8.8	961,700	17.00	16,349,000
Cantaloupes 1925	93,080	Crate	151	14,013,000	1.32	18,483,000
1924	90,510	Crate	148	13,432,000	1.48	19,865,000
Carrots 1925	16,950	Bushel	279	4,727,000	.63	2,928,000
1924	12,220	Bushel	352	4,302,000	.95	4,068,000

TABLE XLVI.—*Summary of United States Crop Report*—Continued

Crop and year		Acreage	Production			Farm value Dec. 1[1]	
			Unit	Per acre	Total	Per unit	Total
Cauliflower	1925	15,130	Crate	228	3,452,000	$1.18	$4,081,000
	1924	12,900	Crate	212	2,735,000	1.18	3,218,000
Celery	1925	22,600	Crate	299	6,757,000	1.85	12,491,000
	1924	22,710	Crate	297	6,741,000	1.85	12,493,000
Corn, sweet	1925	403,150	Ton	2.5	993,000	16.09	15,980,000
	1924	332,230	Ton	1.8	589,500	18.10	10,672,000
Cucumbers	1925	135,870	Bushel	87	11,886,000	1.21	14,414,000
	1924	121,300	Bushel	62	7,473,000	1.49	11,145,000
Eggplant	1925	2,490	Bushel	279	694,000	1.57	1,090,000
	1924	2,660	Bushel	296	787,000	1.57	1,233,000
Lettuce	1925	86,400	Crate	187	16,171,000	1.53	24,767,000
	1924	63,550	Crate	191	12,161,000	1.54	18,671,000
Onions	1925	56,950	Bushel	302	17,173,000	1.15	19,702,000
	1924	60,260	Bushel	296	17,852,000	.94	16,829,000
Peas, green	1925	256,100	Ton	0.9	242,300	68.04	16,486,000
	1924	247,960	Ton	1.1	268,500	64.67	17,364,000
Peppers	1925	12,330	Bushel	257	3,172,000	1.29	4,083,000
	1924	10,960	Bushel	330	3,613,000	1.13	4,085,000
Potatoes, early Irish[7]	1925	287,070	Bushel	103	29,594,000	1.41	41,649,000
	1924	319,610	Bushel	131	41,833,000	.99	41,528,000
Spinach	1925	41,440	Ton	2.4	101,100	74.02	7,483,000
	1924	34,340	Ton	3.1	107,900	68.52	7,392,000
Strawberries	1925	134,000	Quart	1,564	209,586,000	.17	36,105,000
	1924	151,230	Quart	1,829	276,592,000	.13	37,320,000
Tomatoes	1925	456,020	Ton	4.8	2,188,200	27.72	60,656,000
	1924	435,080	Ton	3.7	1,606,700	33.21	53,352,000
Watermelons	1925	156,400	Car	[8]325	50,838	232.00	11,802,000
	1924	168,150	Car	[8]318	53,488	172.00	9,181,000
Total of above	1925	353,021,170					8,611,839,000
	1924	347,217,380					9,182,501,000

[1] Minor crop prices mostly for November 15.
[2] Principal producing States.
[3] Pounds or per pound.
[4] 1924 price per ton is of Nov. 15.
[5] Including beets grown in Canada for factories in the United States.
[6] Trees tapped or per tree.
[7] Included in potatoes, white.
[8] Number

Requests for copies of this report should be addressed to the

Agricultural Statistician,
P. O. Box 1205,
Sacramento, California

INDEX.

A Page

Accredited herd law 215
    operation of 227–228
After foot and mouth, what next? Address—G. H. Hecke 9
Agricultural minerals law 253
    administration of 253
Agricultural representatives on Pacific Coast—Res. 7 59
Alfalfa meal 158–177
    weevil (*Phytonomus posticus* Gyll.) 41
        in California 146
            Lassen and Plumas County 152
        intercepted by inspectors 156
        in Utah 92
Allen, F. W. 63
Allewelt, W. F. 202
Almeria grapes 38
Animal industry division, report of 215
Animal pathology laboratory 217
    tuberculin supplied by 218
Animals slaughtered in foot and mouth eradication 138
Anthrax 219
Anuraphis tulipae 168
Apple crop for 1925 204
    standardization and inspection service 203
Appropriation for regulatory work 99
Argentine ant (*Iridomyrmex humilis* Mayr) 197
Arizona Commission Agriculture and Horticulture—survey of citrus planting on Yuma mesa 160
Association National Commissioners of Horticulture 9
    of Official Seed Analysts of North America 209
Atlantic Monthly 43
Authorization to go out of state 77
Automobiles inspected at quarantine stations 146, 152

B

Babcock and Roese-Gottlieb (Majonnier) methods of dairy testing vs. European methods 261
Bartlett, Dr. O. C., entomologist of Arizona 75, 83, 85
Bennett, W. D. 63
Bennion, Harden, Utah 49, 75, 91, 93
Better business and more uniformity in State and Federal regulatory work—H. A. Henshaw 24
Bishop, T. S., Arizona 75, 83
Blackleg—symptoms and causes 219–220
Blister rust 47
    control of 148–149
Border inspection work 152
    insects taken at quarantine stations from autos 152–155
Brown rot of grape 201
Bubonic plague 148
Buck, Frank H. 48
Buhn, Norman G. 187
Bulbs, eliminating insect pests of 163
    hearing in Washington 6
Bulb pests 163–169
    control measures 169
    fumigation 169
Butter. (*See also* Milk) 242
    commercial scoring of 243–250
    labeling of 243
    standardization of 242
Bureau Agricultural Economics 19
    Dairy control report 235
        functions of 235–236
        projects under 235
    Fruit and vegetable standardization 202
    Grain, seed and warehouse standardization 207
    Plant quarantine and pest control 146
Bureauracy in Washington 23

C

California Agricultural Protective Committee 7
    Committee on Relation of Electricity to Agriculture 239
    Fertilizer Association 255
    Seed Act 208
        covers cereal grains 210
        Laboratory 194
    Standard Apple Act 203
    Warehouse Act 211
Camels' thorn (*Alhagi camelorum*) 193
    eradication 195
    probable introduction in California 193, 194
Campbell, W. G., appointed Director of Regulatory Work, U. S. D. A. 97
Cantaloupes, mildew on 180

Page

Carbon bisulphide in weed control, 196, 197
Car lot inspection of fruits and vegetables, 205
Cattle industry, extent of, 29
    Protection Service Report, 231, 232, 233, 234
    scabies, 215, 220
        animals examined for infection in 1925, 221
        eradication of, 220
        forms of, 221
Cheese, cottage, development of business, 244
    varieties manufactured in California, 243
Chemistry Division, report of, 253
        functions, 253
        in cooperation with Bureau Plant Quarantine and Pest Control to test insecticides, 258
        investigations, 254
        public service, 254
Cherry fruit fly (*Rhagoletis cingulata*), 150
        Quarantine Reg. 13, prohibiting fruit from Oregon, 159
Chestnut bark disease, 158
    blight, 46
    canker, 181
    tortrix, 150
Chinquapin trees, 158
Citrophilus mealybug (*Pseudococcus gahani* Green), 174, 197
Citrus canker, 46
Citrus white fly (*Dialeurodes citri*), 170
        Quarantine Order 41, 159
Codling moth (*Carpocapsa pomonella* Linn), 175
        in walnuts, 170
Cole, Miss Grace M., 194
College of Agriculture, 56
Commercial Fruit Distributors and Plant Quarantine, Frank H. Buck, 48
Conference Deciduous Fruit Growers and Shippers, 63
Convention, Fifty-eighth, Fruit Growers and Farmers, 3
Cooperation Federal and State Quarantine Officers Res. 5, 57
Corn borer, 32
Cotton classing, 211
        office at Bakersfield, 211
            Blythe, 211
            Fresno, 211
    increase in production in San Joaquin Valley, 211
    Seed Certification Act, 212
            purpose of, 212
Country Gentlemen, 43
        Quarantine 37, 36
Coyotes, destruction of, 148
Cream, sampling, weighing and testing of. (*See also* Milk), 246
Crops in California, annual value of, 25
Crop Estimating Service for Poultrymen, Res. 4, 57
    report for 1925, 279
Crown-gall on deciduous fruit trees, 197
Cutter, Geo. H., obituary, 59

D

Dairy Bureau—legal procedure, 251
    imitations, cheese, milk and oleomargarine, 246
    laboratory, 258
        examination of samples, 260
            apparatus, 260
        operation of, 253
        purpose of, 258, 259
    milk inspection, 229
    plant sanitation, 241
    products, standardization of, 250
    statistics, 248
    survey, 237
Daniels, Gilbert H., 32, 36, 37, 40
Deciduous fruit maturity investigations. Dr. J. R. Magness and F. W. Allen, 63
Deer, foot and mouth disease in, 141, 215
Diabrotica beetles (*Diabrotica sorer* Lec.), 177
Dipping vat, illustration of, 166
Division Animal Industry, report of, 215
Direct microscopic count in milk grading, 239
Director of Agriculture (*See* Hecke, G. H.), Regulatory Work, U. S. D. A., 12
Dorset, Dr., U. S. Bureau Animal Industry, 223
Douglas, border station, 89

E

Economic Poison Conference, November 4, 1925, Report of, 61
        law, 253
            administration of, 253, 256
            cancellation of licenses, 257
Eggs, standardization of, 250
Elm leaf beetle (*Galerucella xanthomelaena* Schrank), 176

Page
Entomology, general 172
Estray Cattle Act 231
Eumerus strigatus 165
European earwig (*Forficula auricularia* Linn) 150, 176
fowl plague 30–31, 216
Evaporated and condensed milk, huge increase in production of 245
Examination for County Horticultural Inspectors 149
Expenses of committee re quarantine hearing in Washington 55–56

F

Federal control and centralization of authority in Washington in relation to quarantine matters—J. H. Montgomery 94
government requested to assume leadership of foot and mouth eradication work 11
horticultural board 41, 45, 47, 50, 51, 52, 54
attacked 36
importers of rare plants opposed to 45
opposition to—G. H. Hecke 54
personnel of 37
relating to hearing before 54–55
Intermediate Credit Bank in relation to California-United States Warehouse Act 211
Plant Quarantine Act, maintenance of. Res. 6 58
Federal quarantine regulations 27
must be sustained—Geo. C. Roeding 45
Seed Laboratory, Washington, D. C. 194
—state cooperative commercial scoring 250
shipping point inspection service 204
Fertilizer—tonnage reports 255
and agricultural minerals. Increase in consumption of 254
Law—administration of 253–254
Field crops, data and discussion 283–299
acreage production and value, 1919–1925 284–285
acreage of wheat, barley and oats in California, 1923–1925 286
wheat, production in California, United States and world, 1869–1925 287
barley, production in California, United States and world, 1869–1925 288
rice, acreage, production and farm price by states, 1912–1925 289
grain sorghum, acreage, production and farm price by states, 1916–1925 290
beans, acreage and production, 1920–1925 291
beans, production by varieties, 1920–1925 291
beans, production by varieties in leading bean states, 1924–1925 292
hay, acreage and production by types in California, 1924–1925 293
hay (tame), acreage and production by states, 1924–1925 294
hops, acreage and production, 1923–1925 295
cotton, acreage and production in California by counties, 1923–1925 297
cotton, acreage and production in California, 1919–1925 298
cotton, acreage and production, California, United States and world, 1910–1925 298
Fig scale (*Lepidosaphes ficus*) 177
Fleury, A. C. 149
Foot and mouth disease epizootic in California 135–216
animals slaughtered 138
cooperation from state departments and various outside agencies 144, 145
cost of eradication work 138
disease in deer 141, 215
eggs and baby chicks effected by embargoes 139
embargoes 138
federal cooperation 139
legal and financial aspects 136
legislation, corrective 143
origin 141
quarantines, uniformity of interstate 143
Salt Lake conference regulations 139
Forage poisoning 221
Free Area Law, provisions of 228
Freight cars, inspection and disinfection of for boll weevil infestation 162
Frey, J. J. 235
Fruits, acreages in California, bearing and nonbearing, 1926 307–320
acreage totals, California tree fruits and grapes, 1926 307
acreage, bearing tree fruits in California, 1914–1926 308
acreage, bearing grapes in California, 1919–1926 309
acreage, bearing, forecast of, tree fruits in California 1927–1929 309
acreage, bearing, forecast of, grapes in California, 1927–1928 309
almonds, acreage by counties, 1926 315
apples, acreage by counties, 1926 310
apricots, acreage by counties, 1926 311
cherries, acreage by counties, 1926 312
figs, acreage by counties, 1926 312
grapes, acreage by classes, by counties, 1926 316
grapes, plantings by classes, by counties, 1924–1925 317
grapefruit, acreage by counties, 1926 312
lemons, acreage by counties, 1926 313
olives, acreage by counties, 1926 313

Fruits—Continued. Page
  oranges, acreages by counties, 1926 313
  peaches, acreage by counties, 1926 310
  peaches, acreage by classes, by counties, 1926 318
  peaches, acreage by age and variety in California, 1926 319
  peaches, acreage by age and variety in Northern California, 1926 319
  peaches, acreage by age and variety in Central California, 1926 319
  peaches, acreage by age and variety in Southern California, 1926 319
  pears, acreage by counties, 1926 310
  plums, acreage by counties, 1926 311
  prunes, acreage by counties, 1926 311
  walnuts, acreage by counties, 1926 314
  total acreage, all fruit and nut trees by counties, 1926 314
Fruit and Vegetable Standardization Act 202, 203
Fruit crops, data and discussion 300, 301
    production and value, 1919–1925 302, 303, 304
Funds for carrying on quarantine under Federal Hort. Bd. 59
Fusicoccum sp. relating to chestnut canker 181

G

Garlic, *Tylenchus dipsaci* in 181
Gerber or Fucoma method of testing vs. Babcock and Mojonnier methods 261
Glanders 222
Gordon, George, report on meat inspection 229
Grape, brown rot of 201
  and pear mealybug (*Pseudococcus maritimus* Ehrh.) 174
  phylloxera situation 200
  situation, survey of 198, 199
Grasshoppers 178
Gray, Dr. Geo. P. 61, 253
Greene, Sam H. 31
Gregory, A. R. vs. Hecke, G. H. 62, 257
Grub in head of sheep 224
Gypsy moth 150

H

Hansen, C. J. 273
Hardison, A. C. 32, 75, 80
Hartman, R. D. 197
    resignation of 148
Hayden, Chas. F. Report on Div. Weights & Measures 263
Hebbron, Arthur 231
Hecke, G. H. 9, 12, 26, 28, 49, 51, 54, 63, 75, 76, 90
    foot and mouth disease epizootic in California 135
    letter of transmittal sixth annual report 135
    opening 58th Fruit Growers Convention 9
      address Western Directors and Commissioners of Agriculture 76
    president Western States Agricultural Representatives 101
    vs. Gregory, A. R. 257
Herbicides, commercial 196
Hide and Brand Law 231
  number of brands recorded to date in California 233
  operation of 232
Hinshaw, H. A. Assistant Freight Traffic Manager S. P. Co., San Francisco 24
Hog cholera 222, 223
    procedure advised in an outbreak 223
    vaccination by serum and virus method 223
Holland, bulbs from 168
Holmes, O. W. 273
How to Secure Protection, address by Frank T. Swett 48
Hunt, Ronald 165
Hunter, W. D. 83

I

Ice cream, increase in manufacturing of 244
India, United Province of 172
Insecticides, testing of by Bureau of Plant Quarantine and Pest Control and Division of Chemistry 258
Inspection, interior, automobile 156
    maritime 149
Interpretation of Sec. 9 61
Internal parasites 223
Is Western Agriculture Protected by Present Day Quarantine Practices? Art. by Fred W. Read 40
Iverson, J. P., Report Animal Division 215

J

Jacobsen, W. C., Report Bureau Plant Quarantine and Pest Control 146, 188
    representative Western Directors and Commissioners of Agriculture 75
Japanese beetle 34
Jeffers, L. M., Report Bureau Grain, Seed and Warehouse Standardization 207
Johnson, Ethelbert 190
  appointed collaborator Seed Laboratory in Southern California 209

Page

K

- Kaufman, E. E., California Crop Report for 1925 279
- Kent, Dr. H. L., State College of New Mexico 52, 75, 85
- Keyes, Joseph 188
- Knight, S. S., quarantine as affecting the poultry industry 30
- Koch, Dr. Robert, and the first tuberculin 226

L

- Lassen County, modified accredited area 228
- Leopard egg mass 150
- *Liothrips vaneeckei* 169
- Live stock diseases occurring in California 215
  - cattle scabies 215
  - foot and mouth disease 135–216
    - in deer in Tuolumne County 215
  - Texas fever 215
  - inspection of in field and at shipping points 215
  - value of in California 215
  - estimates, data and discussion 320–326
  - horses, mules and sheep, numbers and value, January 1, 1925–1926 320
  - horses, mules and sheep, number on farms by counties, January 1, 1925–1926 321
  - milk cows, other cattle and swine, numbers and value, January 1, 1925–1926 322
  - milk cows, heifers for milk and swine, number on farms by counties, January 1, 1925–1926 323
  - beef cattle, number on farms by counties, January 1 1925–1926 325
  - horses, numbers and value, California and United States, 1920–1926 320
  - mules, numbers and value, California and United States, 1920–1926 320
  - milk cows (2 years old and over), numbers and value, California and United States, 1920–1926 320
  - all other cattle, numbers and value, California and United States, 1920–1926 320
  - sheep, numbers and value, California and United States, 1920–1926 320
  - swine, numbers and value, California and United States, 1920–1926 320
- Live stock, Meats and Wool Reporting Service 275
- Liver flukes 224
- Lung worms 223
- Lute, Anna M. 194

M

- McBride, Dr., U. S. B. A. I. 223
- McFarland, J. B., Nimbus Ranch, Sacramento 171
- McKevitt, F. B., Individual Grower and Department of Agriculture. Address 38
- McMichaels, E. E. 75, 85
- Mackie, D. B., fumigation of railway cars 157
  - special regulatory pest control 159
- Magness, Dr. J. R. 63
- Maritime inspection 149
  - chart showing increase in passenger traffic and number of parcels inspected 150
- Market News Service 273
  - functions of 273
  - reports broadcasted 274
    - issued 273
- Market milk, improvement in quality of 236
  - specialist's report 238
- Marlatt, Dr. C. L. 83
- Mealybugs 33
  - spread of through picking boxes 170
- Meat inspection 229
  - animals slaughtered 230
  - carcasses and parts condemned 230
  - progress of in California 229–230
  - report of service 229
- Mediterranean fruit fly 13, 27, 41, 149, 150
- Melon fly 149–150
- *Merodon equestris* on narcissus and iris 163
- Merritt, Ralph P., rep. at President's Agriculture Conference 77
- Merryman, R. C. 39
- Metallic poisoning 221
- Meyer, Dr. 31
- Mexican border ports of entry 156
- Mexico, restrictions on fruits from 156
- Milbrath, D. G. 178
- Milk and cream, manufacture of 238
  - bottle losses. Los Angeles Bottle Exchange 241–242
  - cooling of 241
  - grading by direct microscopic count 239
  - market, graded 236
    - survey 237
    - ungraded 237
- Miller, Allen W., violation of Seed Act 210
- Modoc County, modified accredited area 228
- Montgomery, J. H., Gainesville, Florida 50, 75, 80, 94

N

Page

Narcissus bulb quarantine 54–55
  nematode on, ill., Fig. 7 180
  Santa Cruz areas in bloom, ill., Fig. 8 181
  Tylenchus dipsaci in 182, 187
National Association of Secretaries and Commissioners, next meeting 102
  Res. 3 56
National Grange 9
  meeting of in Sacramento 53
Naval Order No. 147 146, 150, 151
Nematode on narcissus 180
Nevada, cooperation of with federal government 87
New Mexico College of Agriculture and Mechanic Arts 97
Nogales, border station 89
Nougaret, R. L. 198
Nursery service 197
  stock handling in California and in Florida 95

O

Oakley, Dr. R. A. 24
Oleomargarine manufactured in California during fiscal year June 30, 1925 246
Onion seed, germination of 209
Oranges, frozen shipments of—C. C. Teague 37
Orchard pests 170
Oriental fruit moth (*Laspeyresia molesta*) 34, 46, 158
Outlook 43

P

Pacific Agricultural Credit Corporation 28
  Fruit Express Co. 25
Paper quarantines 94
Park, Chas. A., Oregon 75
Pear leaf rust mite (*Epitrimerus pyri*) 175
Pest Control Ruling "A" 160–161
Philadelphia, port of 89
Phylloxera situation 200
  in 1925 148
Pickett, John E. 53
Picking boxes, act relating to 147
  sterilization of with steam for control of pests 170
Plant diseases 178
  losses and causes 179–180
  report on 179
Plant pathology 178
  Quarantine—The Growers Interest. Art. by A. C. Hardison 32
  in Utah 49
Poisonous plants 222
Pomelo from China, citrus canker on 181
Poole, Chas. G. 188
Poplar trees, entry prohibited 159
Port inspection work, Philadelphia, Boston, New York, Baltimore, New Orleans, etc. 42
Potato beetle 159
  seed certification service 205
  treatment by vacuum fumigation for meeting other state regulations 170
Poultry industry as affected by quarantines 30
  number cars shipped into California during 1925 217
Predatory animal control 188
  cooperation of counties with 188
  report of animals 189
President's Agricultural Conference 99
Pressure tester for determination of fruit maturity 67
Protectorate of Morocco 172
Prunes, sugar content of oil sprayed 174
Puncture vine (*Tribulus terrestris*) 32
  control situation 190, 191, 192, 193
  germination of 209
  work 147
Pure milk law 215
  testing, amount done in 1925 227

Q

Qua-sul 257
Quarantines 15, 16
Quarantine No. 37 in Country Gentlemen 36
  No. 39—Reg. 8 157
  No. 41 159
  No. 35 159
  Reg. No. 13 159
  effect of on Oregon 89
  foot and mouth disease 27, 45, 76
  measures. Foot and mouth disease illustrate need for 10
  not for trade protection 11
  paper 94

Quarantine—Continued. Page
problems, interstate 58
standardization of 30
standardization and quarantine, differentiation 36
uniformity of 22

R

Rabies 189
Railway cars, disinfection of 157
Ramsay, T. H., president Pacific Live Stock Association 28
Read, Fred W. Is Western Agriculture Protected by Present Day Quarantine Practices 40
Record, Dr. Edward 87
Red spider (*Tetranychus telarius* Linn) 173
Regulatory bureaus in United States 82
history and the live stock industry, T. H. Ramsay 28
pest control, special 159–160
work from citrus growers viewpoint. Art., C. C. Teague 36
work and scientific investigation, separation of 23–24
what Florida has done in. J. H. Montgomery 50
Relation of Producer to Consumer in Modern Agriculture. Lloyd S. Tenny 16
Resolution Committee Fifty-eighth Fruit Growers Convention, personnel 28, 31
Western States Agricultural Representatives 103
Rhizoglyphus hyacinthi infestations 167
Richardson, Governor Friend Wm. 15, 76
Ritzema Bos 182
Rodent Control Activities 147, 187
Roeding, George C. 45, 55
Round worms (*ascarides*) in swine 224
chickens (*Heterakis inflexa*) 224
turkeys (*Heterakis gallinae*) 224
Russian knapweed (*Centaurea repens*) 194, 195

S

Satin moth 159
Salt Lake Conference Regulations 139
Scabies in cattle 220
sheep 225
Schneider, W. E. 273
Schweiss, Geo. G., Field Entomologist University of Nevada 75, 87
Scott, C. E. 182, 183
Seed Act, functions of 207
purpose of 207
inspection 208
laboratory 207
California cooperation recognized by Association of Official Analysts of America 209
received for test at laboratory 208
Service and Regulatory Announcement No. 97 63
Sheehan, E. M. 39
Sheep, grub in head of 224
scabies 225
Sherman, Wells A. 63
Shipping point inspection service 204
Smith, Everett L. 197
Loren E. 83
Special Publication No. 53—Directory Nurserymen and Seedsmen 197
Spence, C. E., Oregon 50, 75, 88
Spencer, A. T., president California Woolgrowers' Association 21, 22
necessity for uniform enforcement of quarantine for the live stock industry 22
Spray burn soluble sulphur 172, 173
materials 147
oils, commercial 173
Standardization and quarantine differentiation 36
transportation and refrigeration of deciduous fruits. Res. No. 2 56
Stanislaus National Forest 189
Star thistle 32
State Board of Control 76
Statistics, dairy 248
State rights in case of invasion of foreign enemy, G. H. Hecke 97
Stockton inspection office moved to Vallejo 207
Strong, Lee A. 75, 81, 83, 101
Survey of dairies 237
grape situation 198, 199
Sweet potato weevil, Quarantine Order 35 159
Swett, Frank T. 48

T

Tables, ripening changes 69–74
Taylor, R. H. 52, 53
Teague, C. C. 9, 14, 36
Tehama County, free area progress 228
Tenny, Lloyd S. 16, 63

Page
Testers, duties of under General Dairy Law 247
    requirements for license to test under California Department of Agriculture 246, 247
Texas fever 215, 225
    in Kings County 226
        San Diego County 226
            eradication measures 226
Thompson, Firman 254
Thurberia boll weevil 157
Tomato crop, western blight 180
Trade questions and the Federal Horticultural Board 80
Tuberculin—number animals tested in 1925 218
    what it is and preparation in pathology laboratory 218
    tests conducted in 1925 229
Tuberculosis bill 29
    accredited herd law enacted in 1921 227
    eradication work done in 1925 229
    free area law 215
        enacted in 1921 227
    organism responsible for 226
    pure milk law enacted in 1915 as eradication move 227
Tylenchus dipsaci, control of in narcissus 182–187
    in England 183

U

Uniform seed law 207
Urbahns, T. D. 172
United States Bureau Animal Industry cooperating with state department in accredited herd law 227
    Biological Survey 187
    Department of Agriculture, figures from covering fruit and vegetable shipments from California 203
    Plant Introduction Gardens 181
    Post Office Department cooperation with Seed Laboratory 210
    Summary Crop Report, 1924–1925 326–329
    Warehouse Act 210–211

V

Vacuum fumigation 160, 161
    illustration 164
    improvements in methods 171
    progress in 146
Van Slogteren 183
Vegetable crops 305–306
    acreage, 1921–1925 305
    value, 1921–1925 305
    carlot shipments from California, 1921–1925 306
Ventura County, inspection of oil tankers in 152
Virden, C. E. 39
Viticultural service 198
Viticulturist, special investigation to determine effects of drought 148

W

Wallace, Henry C., Secretary of Agriculture 19
Walnut codling moth 170
Warehouses, bonded 210–211
Weed control, activities 147
    report of service 190
Weights and Measures Division 263
    functions 263
    report of division 263–272
Weishaar, L. J. 63
Western blight in tomatoes 180
    Directors and Commissioners of Agriculture,
        resolutions adopted 103
        personnel of 75
    leaf-footed plant bug (*Leptoglossus zonatus, Dall.*) 177
    Plant Quarantine Board 35, 76
        Transportation Committee. Resolution by regarding Federal Horticultural Board 86
    States Agricultural Representatives. Officers elected November 6, 1925 101
White pine blister rust 47
    control 148, 149
    in Oregon 158
Wilkinson, W. S. 208
Willow trees entry prohibited 159
Wilson, R. N. 53
World's work 43

45682 8-26 8150

26552 · 1